CHAPTER 6

INJURIES TREATED IN OUTPATIENT CLINICS: SURVEYS AND RESEARCH DATA

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Figures

Section I. Description of Survey and Research Efforts

6-1. Introduction

Potential databases for injury research include hospitalization and outpatient surveillance databases, data from cohort studies, and morbidity reporting. Of these, the hospitalization databases have been the most heavily utilized. Data include patient demographics, duty status, outcome, detailed cause and nature of injury codes (ICD9-CM, up to 8 diagnosis fields and 8 procedures), residual disability (about 300 codes) and a service-specific code for military occupation (about 1200 codes). A major strength of military hospital discharge data is the inclusion of the Social Security Number, making it possible to link information between databases and across multiple admissions for the same injury episode.

Although the hospital discharge databases offer a tremendous potential for the study of injury, the majority of injuries do not require hospitalization. A more accurate approximation of the scope and magnitude of injuries requires comprehensive outpatient surveillance. An outpatient database could also be utilized to determine outpatient disease rates, identify risk factors, perform cost-benefit analyses, and design preventive interventions. An outpatient surveillance system was developed at the Naval Health Research Center for the purpose of supporting epidemiological research in musculoskeletal injuries. This PC-based software application contains information regarding personal demographics, medical presentation, diagnoses, and disposition and has been utilized to develop and evaluate preventive interventions. The system was implemented in several Navy and Marine Corps training sites since 1994, but has since been replaced at most sites with the Ambulatory Data System (ADS).

The majority of injuries in the military do not result in death or require hospitalization. As a consequence, an accurate approximation of the scope and magnitude of injuries requires comprehensive outpatient surveillance. Numerous field studies have been conducted over the years, the purpose of which has been to understand and define injury risk factors or test interventions. These studies have served as the model for field injury research.

For some time, both the Army and Navy have maintained research databases that collect and manage the following information on injury visits to outpatient clinics:

- Types of injuries.
- Severity of injuries.
- Risk factors.

These research databases provide invaluable data for the understanding of the extent of the injury problem and the design of effective interventions to prevent injuries. The databases discussed in this chapter are maintained at the U.S. Army Research Institute of Environmental Medicine (USARIEM) in Natick, Massachusetts, and the Naval Health Research Center (NHRC) in San Diego, California.

In addition to these service-specific research databases, tri-service outpatient data became available for routine surveillance in December 1997. This system, called the ADS, captures patient data on all outpatient visits in DoD facilities worldwide. The system provides access to automated outpatient diagnosis and treatment information. Outpatient injury and disease data are now integrated with personnel data for all three services by the Army Medical Surveillance Activity (AMSA).

6-2. Mission

The mission of the scientific organizations that maintain these databases is to operate their respective outpatient injury research programs in support of DoD and the respective military service medical departments. This information is necessary to prioritize and structure prevention strategies and to inform leaders and trainers, among others.

6-3. Purpose

The primary purpose of the outpatient injury research databases is to address specific questions regarding injury incidence and risk factors to determine how to prevent losses of manpower due to injury.

6-4. Authority

- **USARIEM.** By Section 6, General Order No. 33, Department of the Army, 20 September 1961, and General Order No. 40, Office of The Surgeon General, 1 December 1961, USARIEM was established a Class II medical activity.

- **NHRC.** Originally designated the U.S. Navy Medical Neuropsychiatric Research Unit, by authority of the Chief of Naval Operations, OPNAVNOTE 5450 Ser 09B33/4248 dated 5 August 1974, the unit was redesignated as the NHRC effective 1 September 1974.

Section II. Epidemiology of Injuries and Risk Factors from Medical Research

6-5. Army

The Army data are presented in five parts:

- Incidence of injury is discussed on pages 6-7 through 6-11.
- Rates of injury vs. illness are discussed on pages 6-12 and 6-13.
- Distribution of injury types is discussed on pages 6-14 through 6-17.
- Risk factors are discussed on pages 6-18 through 6-49.
- Multiple risk factors are discussed on pages 6-50 through 6-55.

Incidence of Injury.

An *injury*, as defined in this chapter, is dermatologic or musculoskeletal damage resulting from an external force of repetitive or traumatic nature.

- *Overuse injury* results from tissue damage due to repetitive, cumulative micro-trauma (e.g., tendinitis, stress fractures, patellofemoral syndrome). Overuse injuries account for almost 75% of all injuries among trainees during basic training.
- *Traumatic injury* results from tissue damage due to sudden, overload trauma (e.g., sprains, fractures, contusions, dislocations, lacerations). Traumatic injuries account for approximately 25% of all injuries among trainees during basic training.
- *Stress fracture* results from bone injury due to repetitive loading (overuse such as marching or running). Diagnosis is based on clinical findings plus a positive x-ray or a positive bone scan (if available). Stress fractures are of interest to the military since there are high rates in basic training and other vigorously active populations, resulting in a substantial loss of training time.

Over 80% of military training injuries involve the lower extremities; upper extremity injuries account for less than 20% of all injuries.

Table 6-1 displays the incidence of injuries among men and women during Army basic training in 1980, 1983, 1984, 1988, and 1995.

- The incidence of injuries among men ranged from a low of 23% in 1983 to a high of 27% in both 1984 and 1988.
- The incidence of injuries among women ranged from a low of 42% in 1983 to a high of 67% in 1995.
- Incidence of injuries among women during basic training tended to be about twice that of men.

Table 6-1. Army - Incidence (%) of Injuries Among Men and Women in Basic Training*

Year	Men		Women		Rate Ratio† (Women/Men)
	n	(%)	n	(%)	
1980[1]	770	26%	347	54%	2.1
1983[2]	3,437	23%	767	42%	1.8
1984[3]	124	27%	186	51%	1.9
1988[4]	509	27%	352	57%	2.1
1995[5]	—	—	174	67%	—

* 8 weeks, Fort Jackson, SC.

† Rate ratio = injury rate/illness rate.

1. Kowal, D.M. "Nature and Causes of Injuries to Women Resulting from an Endurance Training Program." *American Journal of Sports Medicine* 8(4): 265-269, 1980.

2. Bensel, C.K., and R.N. Kish. "Lower Extremity Disorders Among Men and Women in Army Basic Training and the Effects of Two Types of Boots." U.S. Army Natick Research and Development Laboratories, Natick, MA. Natick Technical Report: TR 83/026, January 1983.

3. Jones, B.H., M.W. Bovee, and J.J. Knapik. "Associations Among Body Composition, Physical Fitness, and Injury in Men and Women Army Trainees." In *Body Composition and Physical Performance*, National Academy Press, Washington, DC, 1992, pp. 141-173.

4. Bell, N.S., T.W. Mangione, D. Hemenway, P.J. Amoroso, and B. H. Jones. Injury Etiology and Prevention Selected Topics: High Injury Rates Among Female Trainees: A Function of Gender? DTIC # ADA306073. USARIEM, Natick, MA, 1996.

5. Westphal, K.A., K.E. Friedl, M.A. Sharp, et al. Health Performance and Nutritional Status of U.S. Army Women During Basic Combat Training. U.S. Army Research Institute of Environmental Medicine, Natick, MA. Natick Technical Report 96-2, November 1995.

Table 6-2 displays the risk of injury (cumulative incidence, %) among men and women in Army basic training in 1984.

- Overall risk of injury was almost twice as high among women.
- Risk of stress fractures among women was over 5 times higher.

Table 6-2. Army - Risk of Injury (Cumulative Incidence, %) Among Men and Women in Basic Training,* 1984

Type of Injury	Men (%)	Women (%)	Risk Ratio (Chi sq, women vs. men, $p < .05$)
All	27.4%	50.5%	1.8
Lower Extremity	20.9%	44.6%	2.1
Stress Fracture	2.4%	12.3%	5.1
Time Loss†	20.2%	30.1%	1.5

n (men) = 124; n (women) = 186.

* 8 weeks, Fort Jackson, SC.

† The percentage of men and women who lost one or more duty days as a result of a profile for an injury.

Source: Jones, B.H., M.W. Bovee, J.M. Harris, and D.N. Cowan. "Intrinsic Risk Factors for Exercise-Related Injuries Among Male and Female Army Trainees." *American Journal of Sports Medicine* 21(5):705-10, 1993.

Rates of Injury vs. Illness.

Table 6-3 displays the rates of injury and illness among a sample of men and women in Army basic training in 1984.

- The rate of injury-related sick call visits among men is similar to the rate of illness-related sick call visits (14 visits per 100 trainees per month versus 18 visits per 100 trainees per month, respectively).
- The rate of injury-related sick call visits among women is almost the same as the rate for illness-related sick call visits (about 25 visits per 100 trainees per month).
- Men have lower rates of both injury and illness sick call visits as compared to women (14 and 18 visits per 100 trainees per month versus 25 and 24 visits per 100 trainees per month, respectively).
- The rate of injury-related limited duty days among men is significantly higher than the rate of illness-related limited duty days (40 days per 100 trainees per month versus 8 days per 100 trainees per month, respectively).
- The rate of injury-related limited duty days among women is substantially higher than the rate of illness-related limited duty days (129 days per 100 trainees per month versus 6 days per 100 trainees per month, respectively).
- Men have a lower rate of injury-related limited duty days than women (40 days per 100 trainees per month versus 129 days per 100 trainees per month, respectively).
- Men have a slightly higher rate of illness-related limited duty days than women (8 days per 100 trainees per month versus 6 days per 100 trainees per month, respectively).

Table 6-3. Army - Rates of Injury and Illness Among Men and Women in Basic Training,* 1984

Types	Rate (n/100/mo)		Risk Ratio†
	Injury	Illness	
One or more sick call visits - Men	14	18	0.8
One or more sick call visits - Women	25	24	1.0
Days of limited duty - Men	40	8	5.0
Days of limited duty - Women	129	6	22.0

n (men) = 124; n (women) = 186.

* 8 weeks, Fort Jackson, SC.

† Risk ratio = injury rate/illness rate.

Source: Jones, B.H., R. Manikowski, J.R. Harris, et al. Incidence of and Risk Factors for Injury and Illness Among Male and Female Army Basic Trainees. U.S. Army Research Institute of Environmental Medicine Technical Report No. T19/88, 1988.

Distribution of Injury Types.

Table 6-4 displays the frequency and distribution of injury types for all sick call visits among men and women in Army basic training in 1984. The top three injuries for men were:

- Musculoskeletal pain—32.7%.
- Low back pain—16.4%.
- Tendinitis—14.5%.

The top three injuries for women were:

- Musculoskeletal pain—37.5%.
- Stress fracture—19.7%.
- Muscle strain—16.3%.

Table 6-4. Army - Frequency and Distribution (%) of Injuries by Type for All Sick Call Visits Among Men and Women in Basic Training,* 1984

Types of Injury	Men		Women	
	n	%	n	%
Musculoskeletal Pain	18	32.7%	55	37.5%
Low Back Pain	9	16.4%	3	2.0%
Tendinitis	8	14.5%	10	6.8%
Sprain	6	10.9%	11	7.5%
Stress Fracture	4	7.3%	29	19.7%
Muscle Strain	3	5.5%	24	16.3%
Overuse Knee Pain	1	1.8%	5	3.4%
Blisters	1	1.8%	6	4.1%
Other	5	9.1%	4	2.7%
TOTAL	55	100.0%	147	100.0%
Injury sick call visits per 100 trainees per week	5.5	—	9.9	—

n (men) = 124; n (women) = 186.

* 8 weeks, Fort Jackson, SC.

Source: Jones, B.H., R. Manikowski, J.H. Harris, et al. Incidence of and Risk Factors for Injury and Illness Among Male and Female Army Basic Trainees. U.S. Army Research Institute of Environmental Medicine, Natick, MA. Technical Report T19-88, June 1988.

Table 6-5 displays the frequency and distribution of lower extremity musculoskeletal injuries among a sample of 303 Army personnel in infantry initial entry training in 1987. The top three specific injuries were:

- Strains—15.1%.
- Ankle sprain—11.0%.
- Overuse knee injury—10.5%.

Table 6-5. Army - Frequency and Distribution (%) of Lower Extremity Musculoskeletal Injuries Among Personnel in Infantry Training,* 1987

Types of Injury	Frequency	% of Total
Pain Not Otherwise Specified	72	41.9%
Strains	26	15.1%
Ankle Sprain	19	11.0%
Overuse Knee Injury	18	10.5%
Stress Fractures	9	5.2%
Fasciitis	7	4.1%
Stress Reactions of Bone	6	3.5%
Other Sprain	3	1.7%
Achilles Tendinitis	3	1.7%
Bursitis	2	1.2%
Fracture	2	1.2%
Unknown or Not Otherwise Specified	5	2.9%
TOTAL	172	100%

n (population/sample size) = 303.

* 12 weeks, Fort Benning, GA.

Source: Cowan, D., B. Jones, J.P. Tomlinson, et al. The Epidemiology of Physical Training Injuries in U.S. Army Infantry Trainees: Methodology, Population, and Risk Factors. U.S. Army Research Institute of Environmental Medicine, Natick, MA. Technical Report T4-89, November 1988.

Risk Factors for Physical Training Injuries.

- **Personal Characteristics and Fitness (Intrinsic) Factors.** Intrinsic and extrinsic risk factors have been examined by U.S. Army researchers over the past decade. Potential intrinsic risk factors include low level of fitness (weaker, slower run time), body fat (high percentage), anatomy (flat feet, bow legs), gender (women), age (older), and prior injury (severe injuries). The following conclusions were reached in studies of trainees:
  - Anecdotal reports, however, have suggested that the shortest women, and possibly men, are at greater risk of injuries during basic training. These reports also seem to indicate that both the leanest and most overweight trainees in basic training may be at a greater risk of injury.
  - Between 1984 and 1988, run times became slower and the number of sit-ups completed on the initial Army Physical Fitness Training (APFT) declined for both men and women.
  - Of all the fitness measures in the APFT, run time is most consistently associated with injury incidence.
- **External (Extrinsic) Factors.** Potential extrinsic risk factors include training parameters (amount, intensity, etc.), equipment (shoes, boots, etc.), and environmental factors (terrain, weather, etc.).
  - A study of men in infantry training showed that a high mileage unit, running 130 miles in 12 weeks, sustained a higher injury incidence and slower final run time as compared to a unit that ran 56 miles in 12 weeks (Jones et al., 1994).

- **Behavioral Health Risks.** Recent studies have examined the association of behavioral health risk factors (i.e., alcohol consumption and smoking habits) prior to entry into the Army and risks of injury during basic training.
  - Male and female trainees who smoked prior to basic training had a higher incidence of injury compared to nonsmokers (Westphal et al., 1995; Jones et al., 1993).
  - Female trainees who drank four to five drinks per week prior to basic training had a 20% greater risk of injury compared to nondrinkers (Westphal et al., 1995).

Table 6-6 displays the personal characteristics and fitness factors among men and women upon entry to Army basic training in 1984 and 1988.

Table 6-6. Army - Personal Characteristics and Fitness Factors Among Men and Women Upon Entry to Basic Training,* 1984 and 1988

Variables	Men (mean)		Women (mean)	
	1984 (n=124)	1988 (n=1,053)	1984 (n=186)	1988 (n=896)
Age (yrs)	20.2	20.1	21.2	20.2
Height (cm)	175.2	175.2	163.3	162.0
Weight (kg)	73.6	75.7	58.7	58.3
BMI (wt/ht2)	24.3	24.6	22.4	22.2
Body Fat (%)	16.9	16.1	25.2	26.8
1-Mile Run (min)	7.2	7.6	9.7	10.3
2-Mile Run (min)	—	16.4	—	20.3
Sit-ups (#)	54.5	44.3	39.7	33.9
Push-ups (#)	31.0	30.5	12.4	10.3

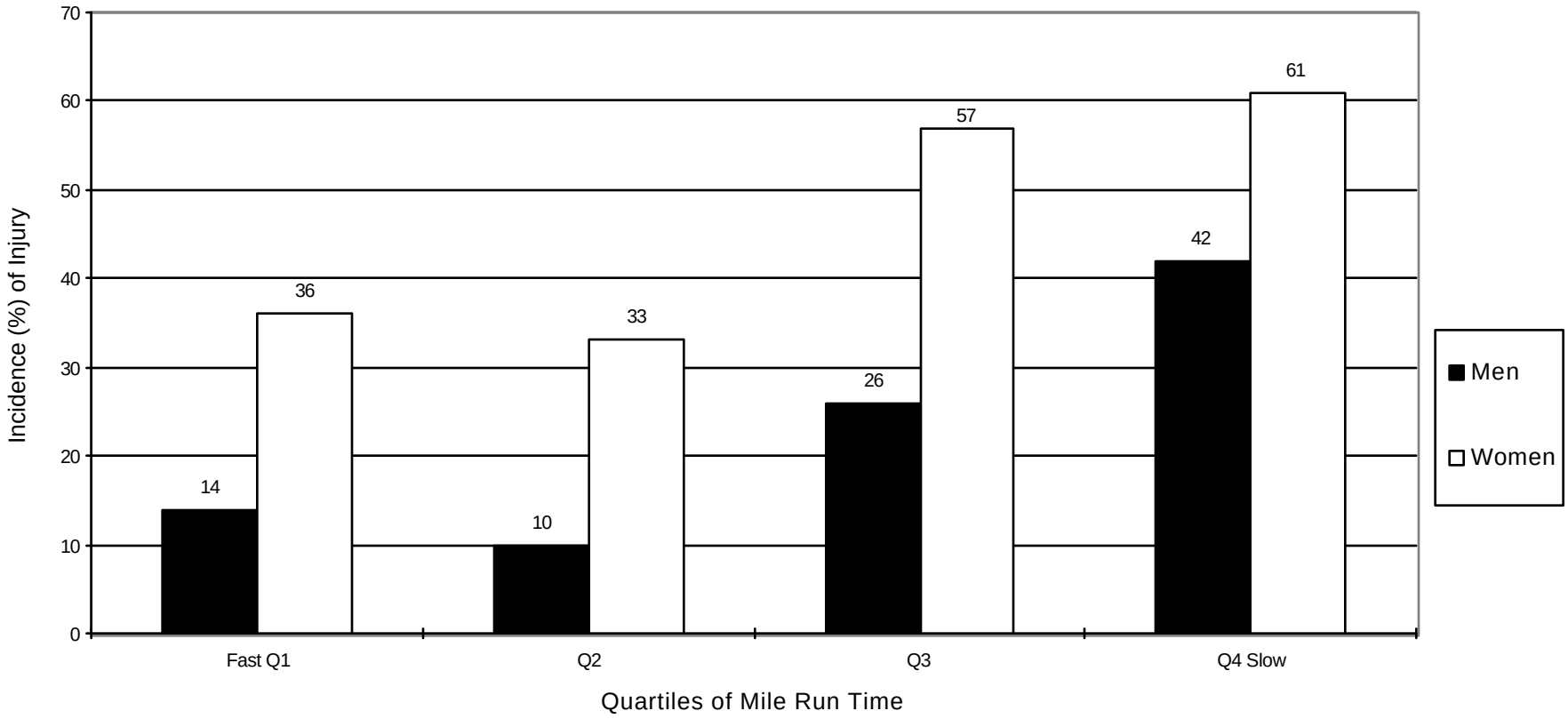
* 8 weeks, Fort Jackson, SC.

Source: Jones, B.H., M.W. Bovee, and J.J. Knapik. "Associations Among Body Composition, Physical Fitness, and Injury in Men and Women Army Trainees." In *Body Composition and Physical Performance*, National Academy Press, Washington, DC, 1992, pp. 141-173.

Figure 6-1 illustrates the run time, a measure of aerobic fitness, and incidence of injury among men and women in Army basic training in 1984.

- Male and female trainees with slow mile run times on the diagnostic APFT showed a higher risk of injury during basic training compared to faster runners.
- The slowest male trainees had 3 times greater risk of injury as compared to the fastest male trainees.
- The slowest female trainees had 1.7 times greater risk of injury as compared to the fastest female trainees.
- For both men and women, the data shows a trend of increasing risk with successively slower run times.

Army - Run Time and Incidence (%) of Injury Among Men and Women in Basic Training,* 1984



n (men) = 79; n (women) = 140.

* 8 weeks, Fort Jackson, SC.

P for trend: men = 0.02; women = 0.03.

Quartile cut points for men (one-mile run in minutes): Q1<6.4<Q2<7.0<Q3<7.7<Q4.

Quartile cut points for women (one-mile run in minutes):

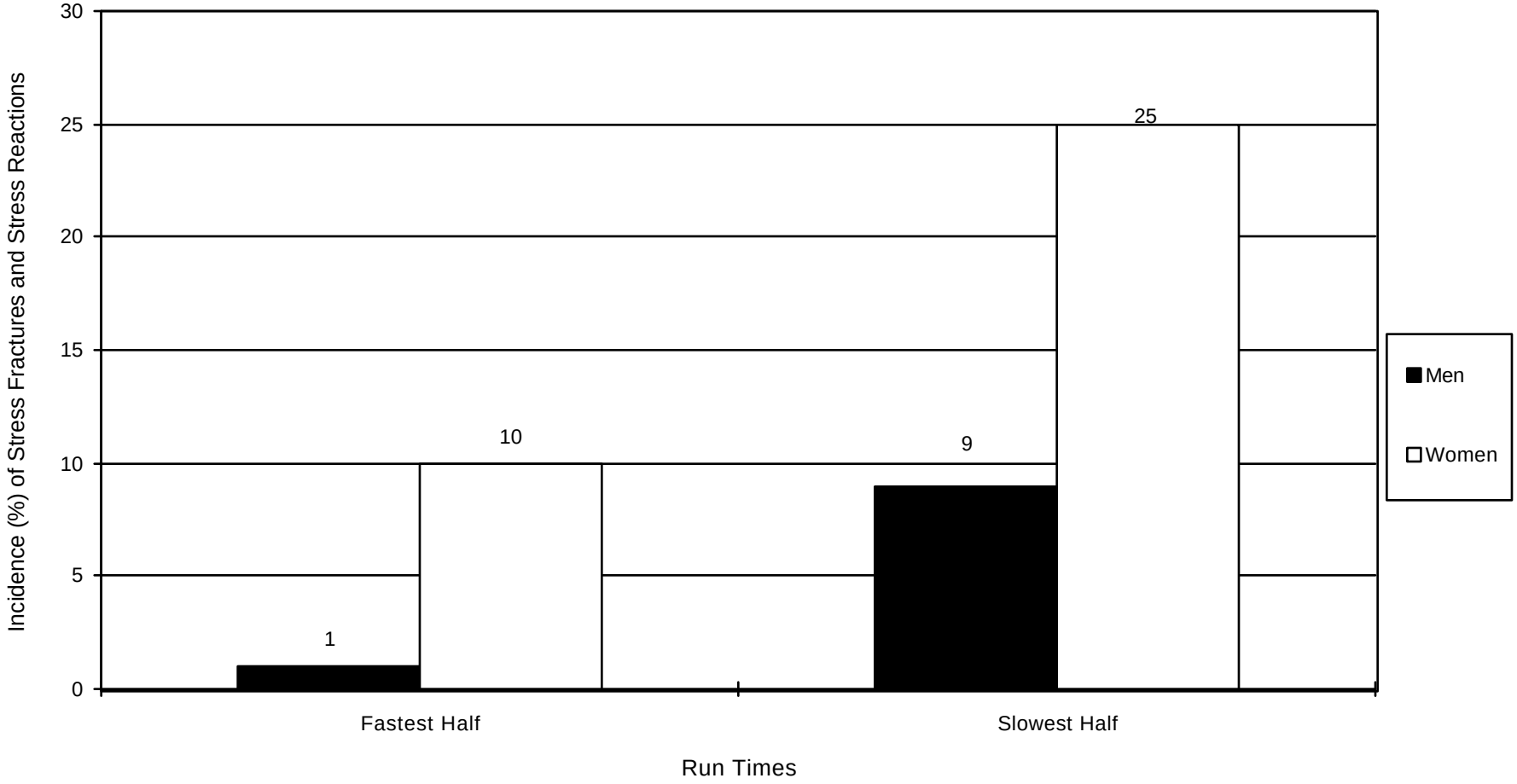
Source: Jones, B.H., M.W. Bovee, and J.J. Knapik. "Associations Among Body Composition, Physical Fitness, and Injury in Men and Women Army Trainees." In *Body Composition and Physical Performance,* National Academy Press, Washington, DC, 1992, pp. 141-173.

Figure 6-1

Figure 6-2 illustrates the run time and incidence of stress fractures and stress reactions among men and women in Army basic training in 1995.

- Stress fractures and stress reactions are common overuse injuries that often result in significant time lost from training.
- The trends are the same as seen with injuries overall; among both men and women, the slower trainees had a higher stress fracture incidence as compared to the faster trainees.
- Women were at a three times greater risk than men of sustaining a stress fracture or stress reaction.

Army - Run Time* and Incidence (%) of Stress Fractures and Stress Reactions Among Men and Women in Basic Training,† 1995



n (men) = 155; n (women) = 95.

* 2-mile run time on diagnostic Army physical fitness test;
median for men = 17.7 minutes, women = 22.5 minutes.

† Two companies in their seventh week of 8 weeks of training, Fort Leonard Wood,

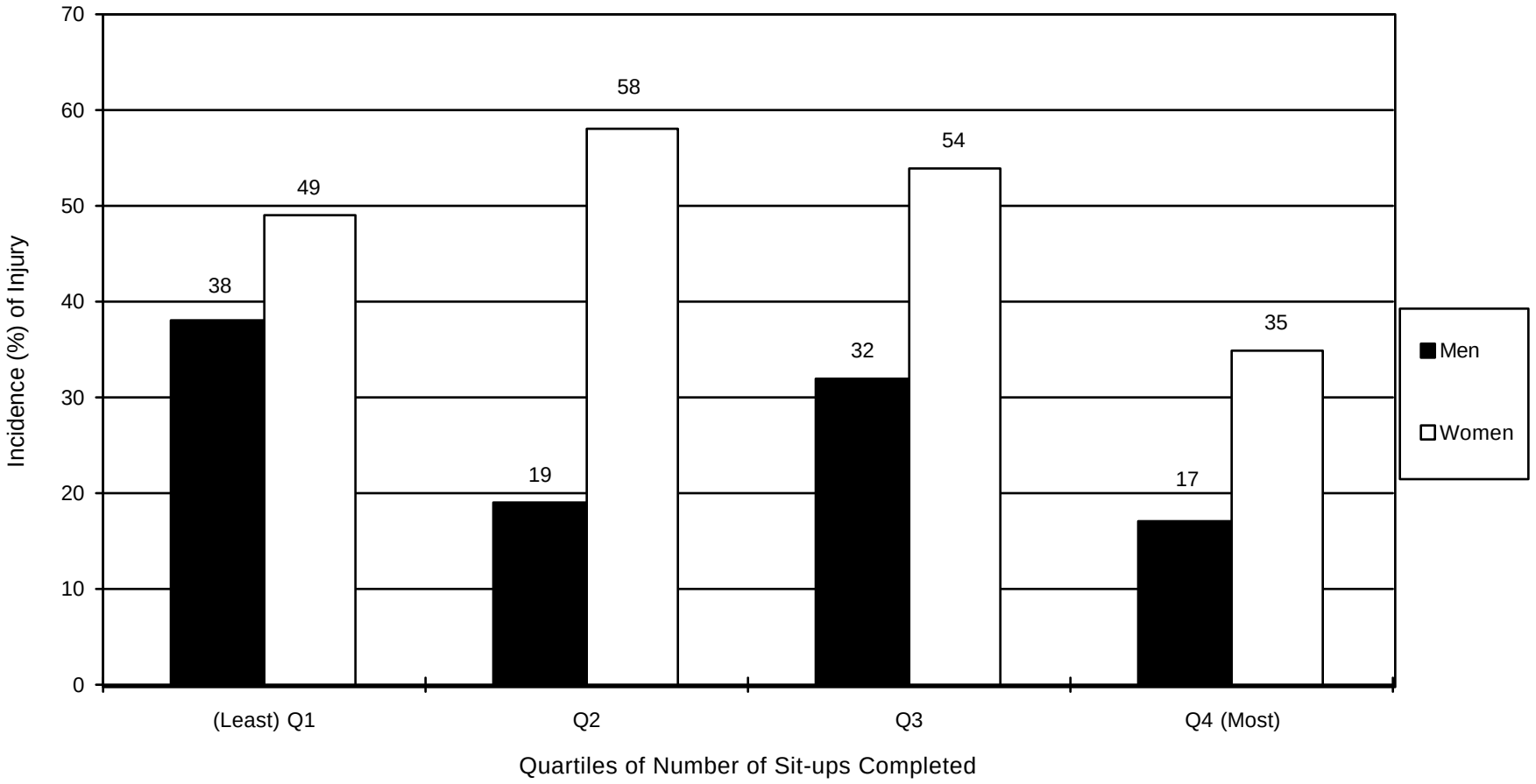
Source: Canham, M.L., M.A. McFerren, and B.H. Jones. "The Association of Injury with Physical Fitness Among Men and Women in Gender-Integrated Basic Training Units." *USACHPPM Medical Surveillance Monthly Report* 2(2):8-10,12, April 1996.

Figure 6-2

Figure 6-3 illustrates the association of sit-ups, a measure of muscle endurance, with incidence of injury among men and women in Army basic training in 1984.

- For both men and women, injury incidence was lower among those who completed the most sit-ups (quartile 4) on the diagnostic APFT.

Army - Sit-ups and Incidence (%) of Injury* Among Men and Women in Basic Training,† 1984



n (men) = 124; n (women) = 186.

* Injury = 1 or more sick call visits for musculoskeletal complaint during basic training cycle.

† 8 weeks, Fort Jackson, SC, diagnostic Army physical fitness test.

Quartile cut points for men: Q1<47<Q2<52<Q3<64<Q4; quartile cut points for women:

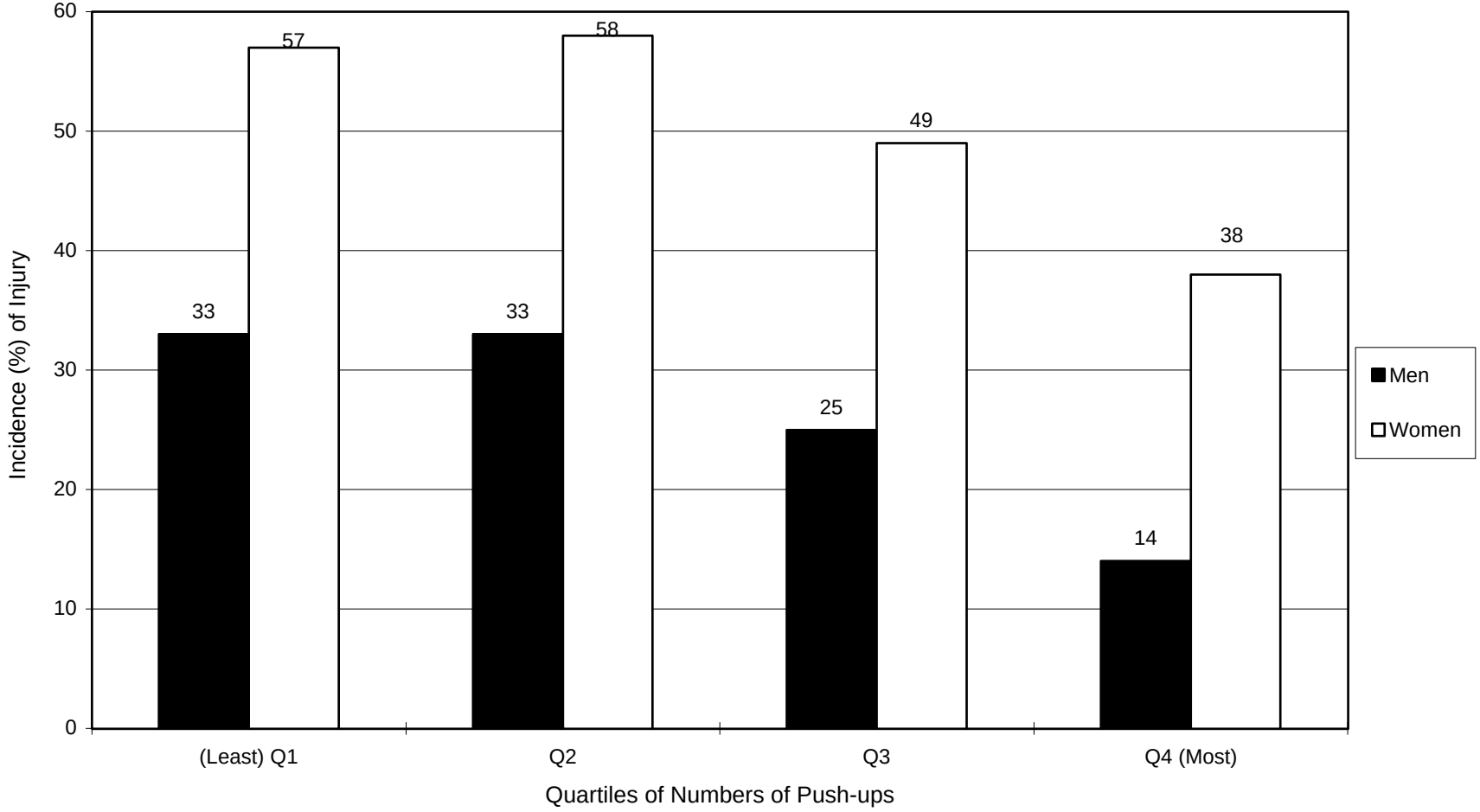
Source: Jones, B.H., R. Manikowski, J.H. Harris, et al. Incidence of and Risk Factors for Injury and Illness Among Male and Female Army Basic Trainees. U.S. Army Research Institute of Environmental Medicine, Natick, MA. Technical Report T19-88, June 1988.

Figure 6-3

Figure 6-4 illustrates push-ups, a measure of muscle endurance, and incidence of injury among men and women in Army basic training in 1984.

- Male and female trainees who performed higher numbers of push-ups (as measured by quartiles of push-ups) had a lower incidence of training-related injuries.

Army - Push-ups and Incidence (%) of Injury Among Men and Women in Basic Training,* 1984



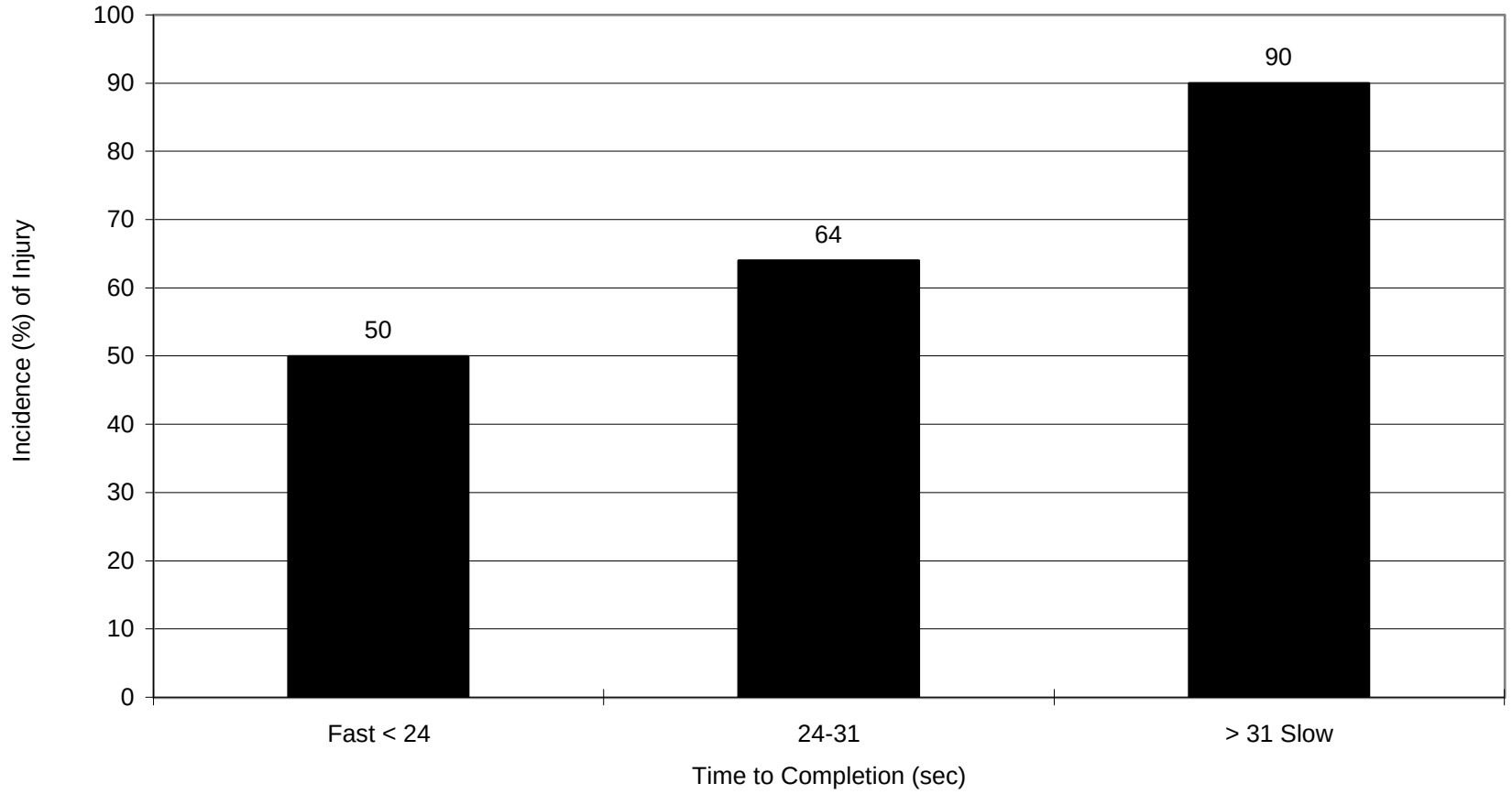
n (men) = 124. MH Chi trend = 2.6; p-value = 0.10. Average push-ups = 31 (+/- 9).
n (women) = 186. MH Chi trend = 3.0; p-value = 0.08. Average push-ups = 12 (+/-10).
* 8 weeks, Fort Jackson, SC.
Quartile cut points for men: Q1<27<Q2<31<Q3<36<Q4; quartile cut points for women: Q1<.5<Q2<11<Q3<17<Q4.

Source: Jones, B.H. Jones, B.H., R. Manikowski, J.H. Harris, et al. Incidence of and Risk Factors for Injury and Illness Among Male and Female Army Basic Trainees. U.S. Army Research Institute of Environmental Medicine, Natick, MA. Technical Report T19-88, June 1988.

Figure 6-4

Figure 6-5 illustrates performance on a load carriage task, a measure of muscle strength and muscle endurance, and incidence of injury among women in Army basic training in 1993. There is a highly significant trend of increasing injury among female trainees with slower load carriage task performance (e.g., lifting an 18.2 kg box and carrying it around a 91.4-meter course for time).

Army - Load Carriage Task and Incidence (%) of Injury Among Women in Basic Training,* 1993



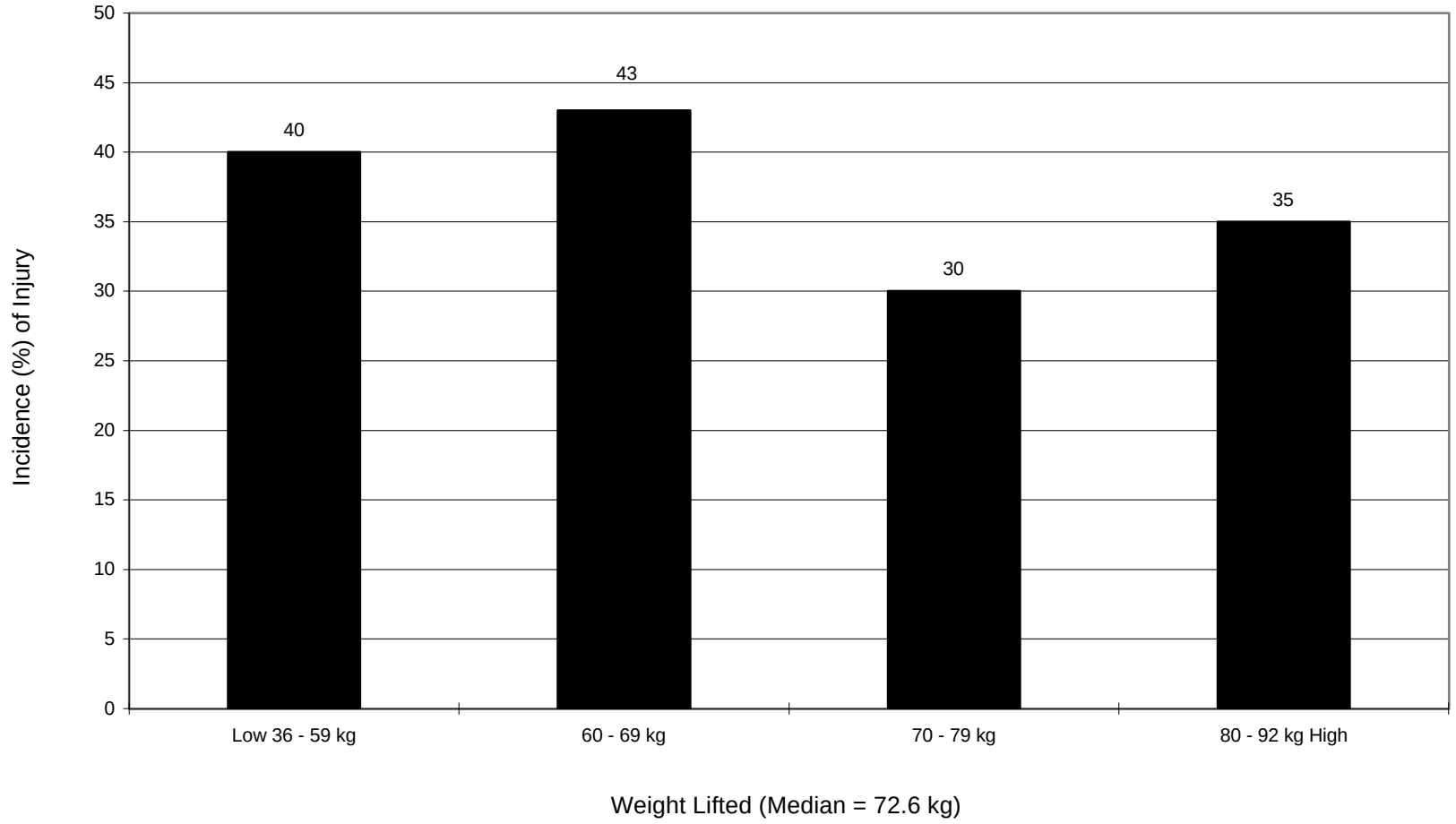
n = 156 (fast = 28; slow = 29).
* 8 weeks, Fort Jackson, SC.
Load carriage task = lift and carry 18.2 kg over distance of 91.4 m.
MH Chi trend = 9.99; p-value = 0.001.

Source: Jones, B.H. 1997. "Physical Fitness and Injuries Among Women in the U.S. Army." *Optimizing the Performance of Women in the Armed Forces of NATO,* Technical Proceedings. AC/243 (Panel 8) PP/13.

Figure 6-5

Figure 6-6 illustrates performance on the dynamic lift test, a measure of muscle strength, and incidence of injury among men in Army infantry initial training in 1987. Male trainees who could lift more weight on a dynamic lift test (e.g., lifting a rack of weights on a machine from floor to chest height) had a slightly reduced risk of injury during the 12 weeks of infantry basic training. Although this association was not significant, risks appeared to lower for those with greater muscle strength.

Army - Dynamic Lift Test and Incidence (%) of Injury Among Men in Infantry Initial Entry Training,* 1987



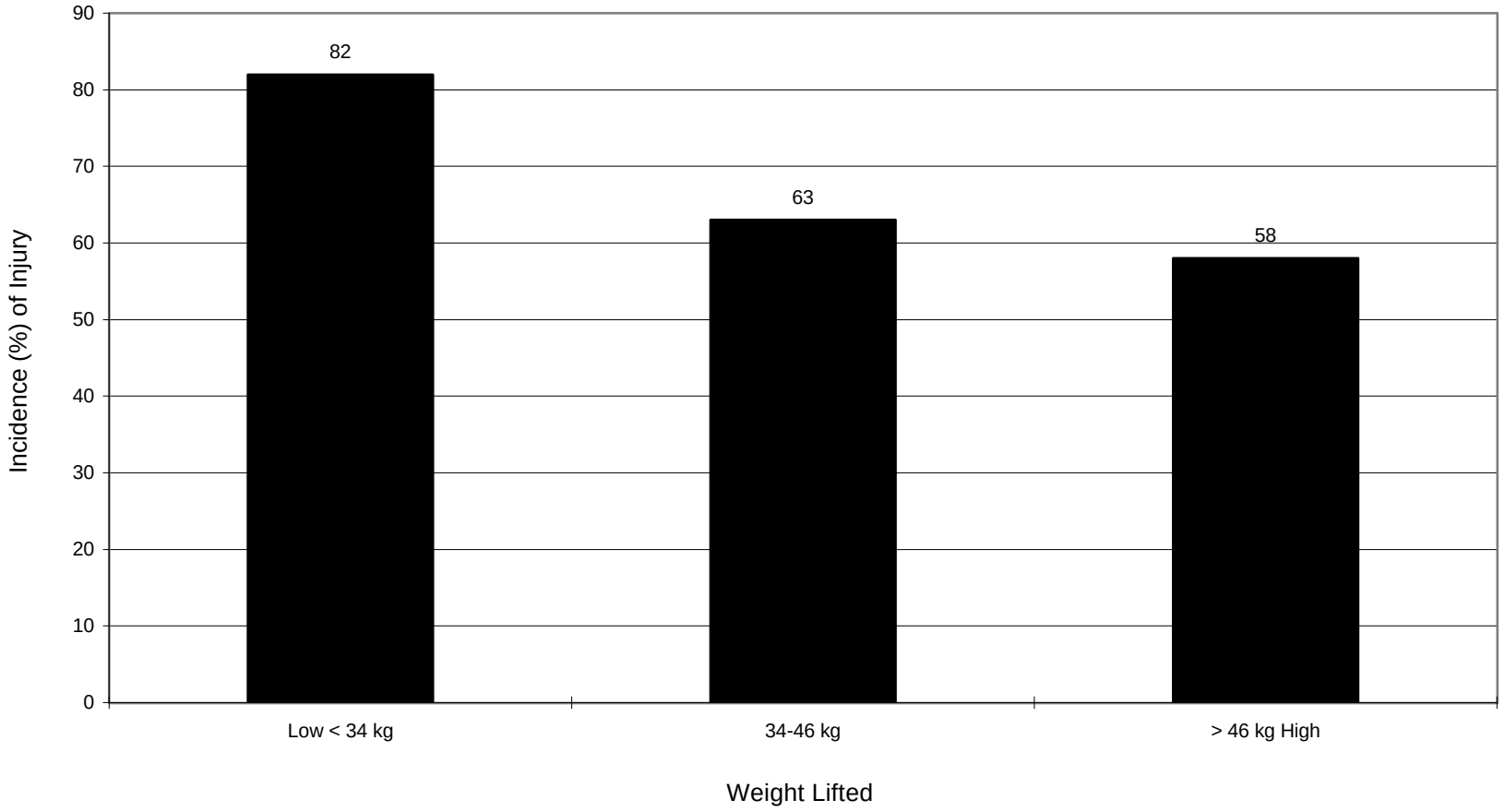
n = 303.
* 12 weeks, Fort Benning, GA.
Dynamic lift test = maximum amount (kg) lifted overhead.
Relative risks (low vs. high) = 1.1.

Source: Cowan D., B. Jones, J.P. Tomlinson, et al. The Epidemiology of Physical Training Injuries in U.S. Army Infantry Trainees: Methodology, Population, and Risk Factors. U.S. Army Research Institute of Environmental Medicine, Natick, MA. Technical Report: T4-89, November 1988.

Figure 6-6

Figure 6-7 illustrates performance on the dynamic lift test, a measure of muscle strength, and incidence of injury among women in Army basic training in 1993. Female trainees showed a similar, though much more significant, trend between lifting more weight and fewer injuries in basic training as compared to men in infantry basic training. A less significant correlation with injury incidence was found when muscle strength was measured using a bench press.

Army - Dynamic Lift Test and Incidence (%) of Injury Among Women in Basic Training,* 1993



n = 158 (n (low) = 34; n (high) = 31).
* 8 weeks, Fort Jackson, SC.
Relative risks (low vs. high) = 1.4; p-value < 0.05.

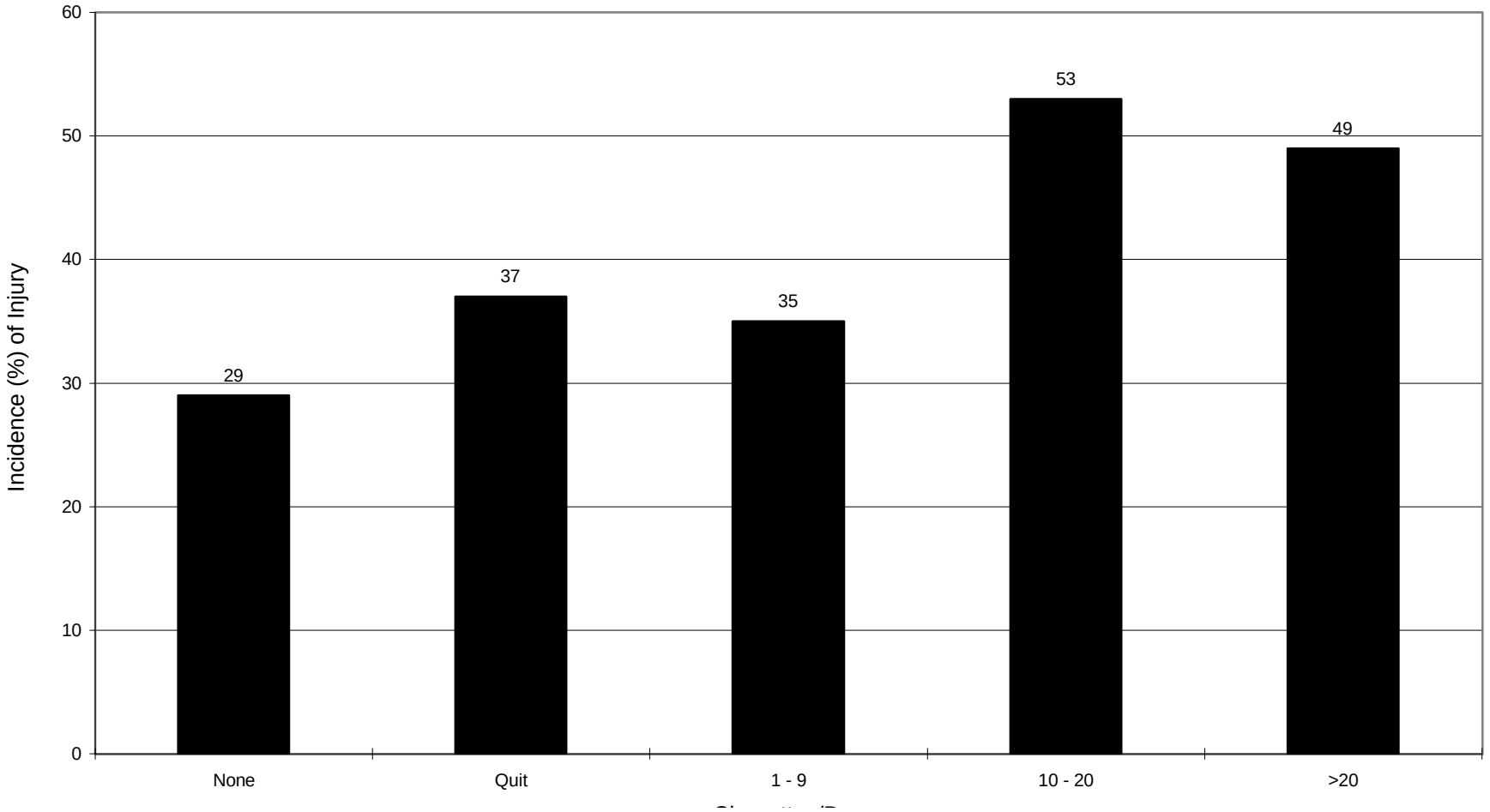
Source: Jones, B.H. 1997. "Physical Fitness and Injuries Among Women in the U.S. Army." *Optimizing the Performance of Women in the Armed Forces of NATO,* Technical Proceedings. AC/243 (Panel 8) PP/13.

Figure 6-7

Figure 6-8 illustrates the relationship of cigarette smoking with the incidence of lower extremity injuries among men in Army infantry initial entry training in 1987.

- The largest incidence of injury occurred among men who smoked between 10 to 20 cigarettes a day prior to basic training (53% vs. 29% for nonsmokers).
- Men who smoked more than 10 cigarettes per day were at significantly greater risk of injury as compared to nonsmokers, those who quit, and those who smoked 1 to 9 cigarettes per day, even when differences in physical fitness were taken into consideration.

Army - Cigarette Smoking and Incidence (%) of Lower Extremity Injuries Among Men in Infantry Training,* 1987



n = 299.
* 12 weeks follow-up, Fort Benning, GA.
Chi sq p < 0.05; odds ratio = 1.9; 95% confidence interval = 1.1,3.3 (smokers > 10 cigarettes/day or nonsmokers).

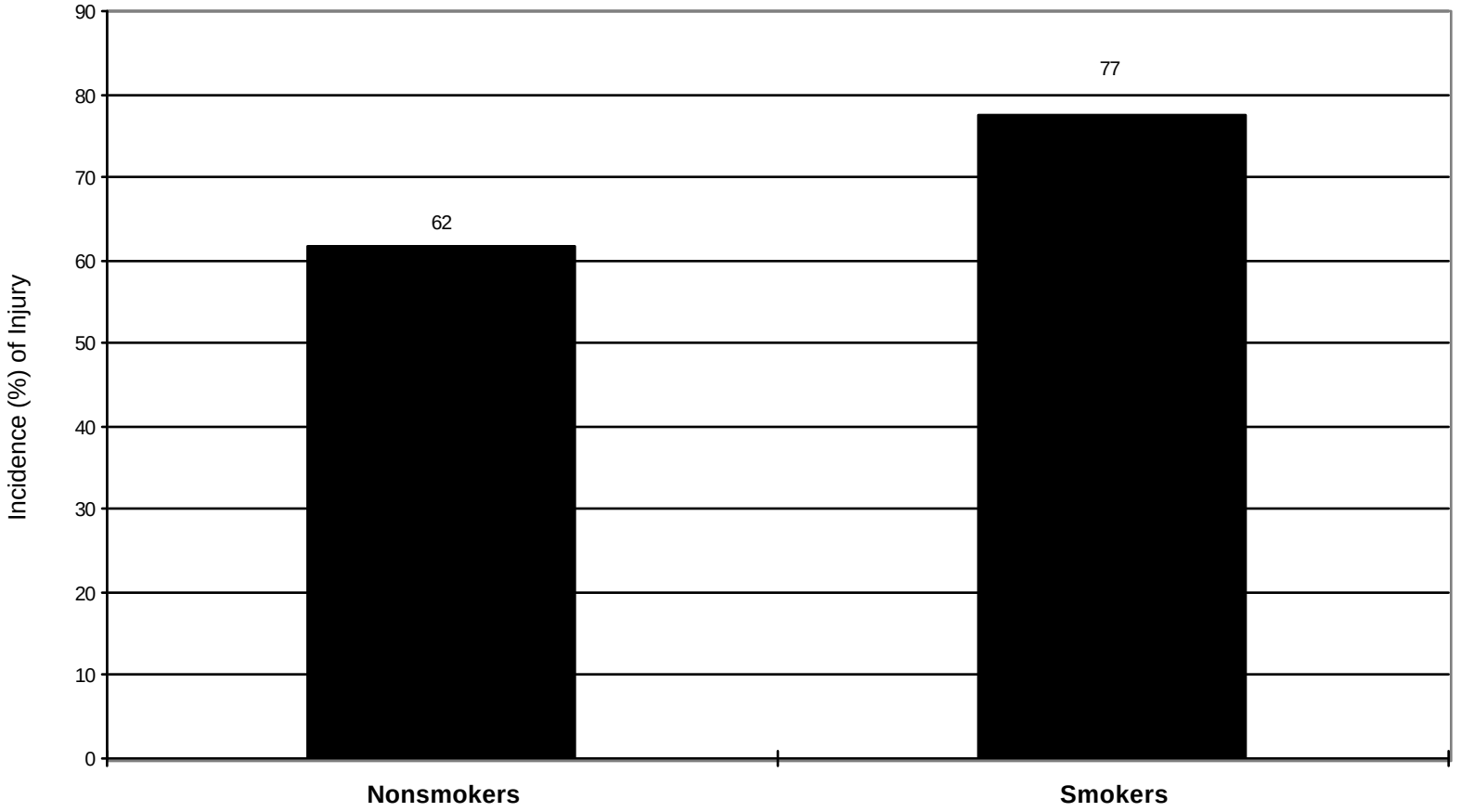
Source: Jones, B.H., D.N. Cowan, J.P. Tomlinson, et al. "Epidemiology of Injuries Associated with Physical Training Among Young Men in the Army." *Med. Sci. Sports Ex.* 25(2):197-203, 1993.

Figure 6-8

Figure 6-9 illustrates the relationship of cigarette smoking with the incidence of injury among women during Army basic training in 1993.

- Injury risk for women who were smokers prior to basic training was 1.2 times higher than the injury risk for nonsmokers.

Army - Cigarette Smoking and Incidence (%) of Injury Among Women in Basic Training,* 1993



n (nonsmokers) = 110; n (smokers) = 53).
* 8 weeks, Fort Jackson, SC.
Relative risk of smokers vs. nonsmokers = 1.25; p-value < 0.05.

Figure 6-9

Source: Westphal, K.A., K.E. Friedl, M.A. Sharp, et al. Health Performance and Nutritional Status of U.S. Army Women During Basic Combat Training. U.S. Army Research Institute of Environmental Medicine, Natick, MA. Natick Technical Report T96-2, November 1996.

Figure 6-10 illustrates the association of alcohol consumption with incidence of injury among women during Army basic training in 1993.

- Injury risk was higher for those who consumed greater amounts of alcohol.

Another study of 15,295 infantry soldiers showed similar results. Those soldiers who reported alcohol use had a 1.25 greater risk of injury as compared to those who reported no alcohol use.*

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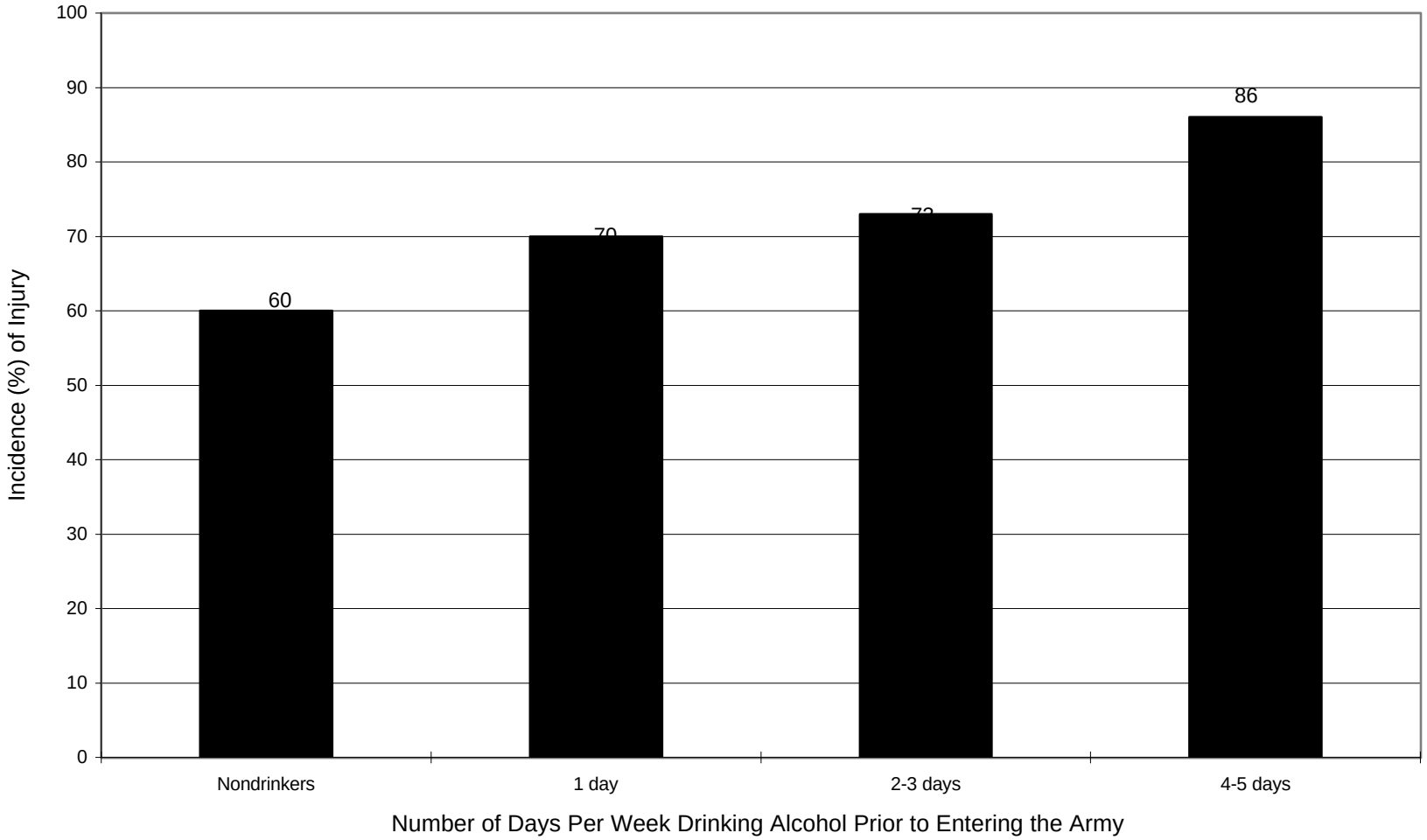
* Tomlinson, J.P., W.M. Lednar, and J.D. Jackson. "Risk of Injury in Soldiers." *Military Medicine* 152(2):60-64, 1987.

Army - Alcohol Consumption and Incidence (%) of Injury Among Women in Basic Training,* 1993



n = 162.
* 8 weeks, Fort Jackson, SC.
Relative risk = low vs. high = 1.43; 95% confidence interval = 0.99-2.06.
Chi sq for trend = 5.3; p-value = 0.02.

Source: Westphal, K.A., K.E. Friedl, M.A. Sharp, et al. Health Performance and Nutritional Status of U.S. Army Women During Basic Combat Training. U.S. Army Research Institute of Environmental Medicine, Natick, MA. Natick Technical Report T96-2, November 1996.

Figure 6-10

Table 6-7 displays the effects of high and low running mileage on injury rates and run times among male personnel in infantry initial entry training in 1987.

- The high-running mileage unit had a 27% higher risk of lower extremity injury than the lower-running mileage unit.
- The high-running mileage unit had a slower average 2-mile run time on the final physical fitness test.
- The higher running mileage increased injury risk and did not impart any additional aerobic endurance benefits.
- This data suggest that there are thresholds of training (running mileages) above which injury rates increase and physical fitness fails to improve.

Table 6-7. Army - Effects of High and Low Running Mileage on Injury Rates and Run Times Among Male Personnel in Infantry Training,* 1987

Mileage	Lower Extremity Injury Incidence (%)	2-Mile Run Time† (minutes:seconds)
Low - 56 miles/12 weeks	33%	13:29
High - 130 miles/12 weeks	42%	13:45
Ratio - high mileage vs. low mileage	1.27	1.02

n (low mileage subjects) = 157; n (high mileage subjects) = 146.

* 12 weeks, Fort Benning, GA.

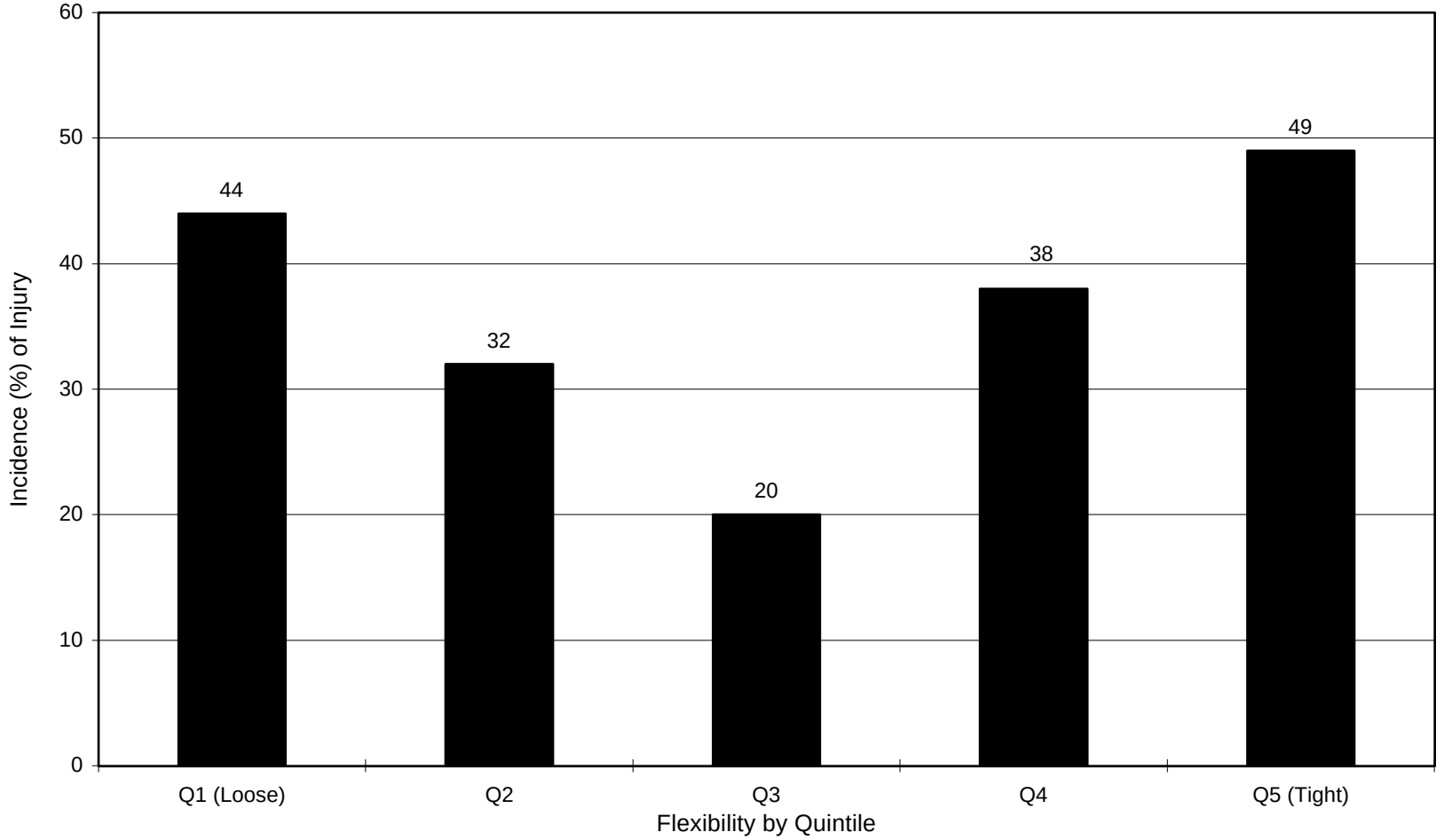
† Final Army physical fitness training average times.

Source: Jones, B.H., and J.J. Knapik. "Exercise, Training, and Injuries." *Sports Med.* 18(3):202-213, 1994.

Figure 6-11 illustrates flexibility and incidence of injury among men in Army infantry initial entry training in 1987. Back and hamstring flexibility were measured with a sit-and-reach test. Degree of flexibility was recorded in number of centimeters reached toward toes (negative numbers before the toes, positive numbers beyond the toes).

- Both the most flexible and the least flexible trainees showed higher incidences of injury than those of "average" flexibility.

Army - Flexibility (Sit and Reach) and Incidence (%) of Injury Among Men in Infantry Initial Entry Training,* 1987



n = 303, median = 4.3 cm (RNG = -23 to 24).
* 12 weeks, Fort Benning, GA.
RR Q1 vs Q3 = 2.2, p-value < .05.
RR Q5 vs Q3 = 2.5, p-value < .05.

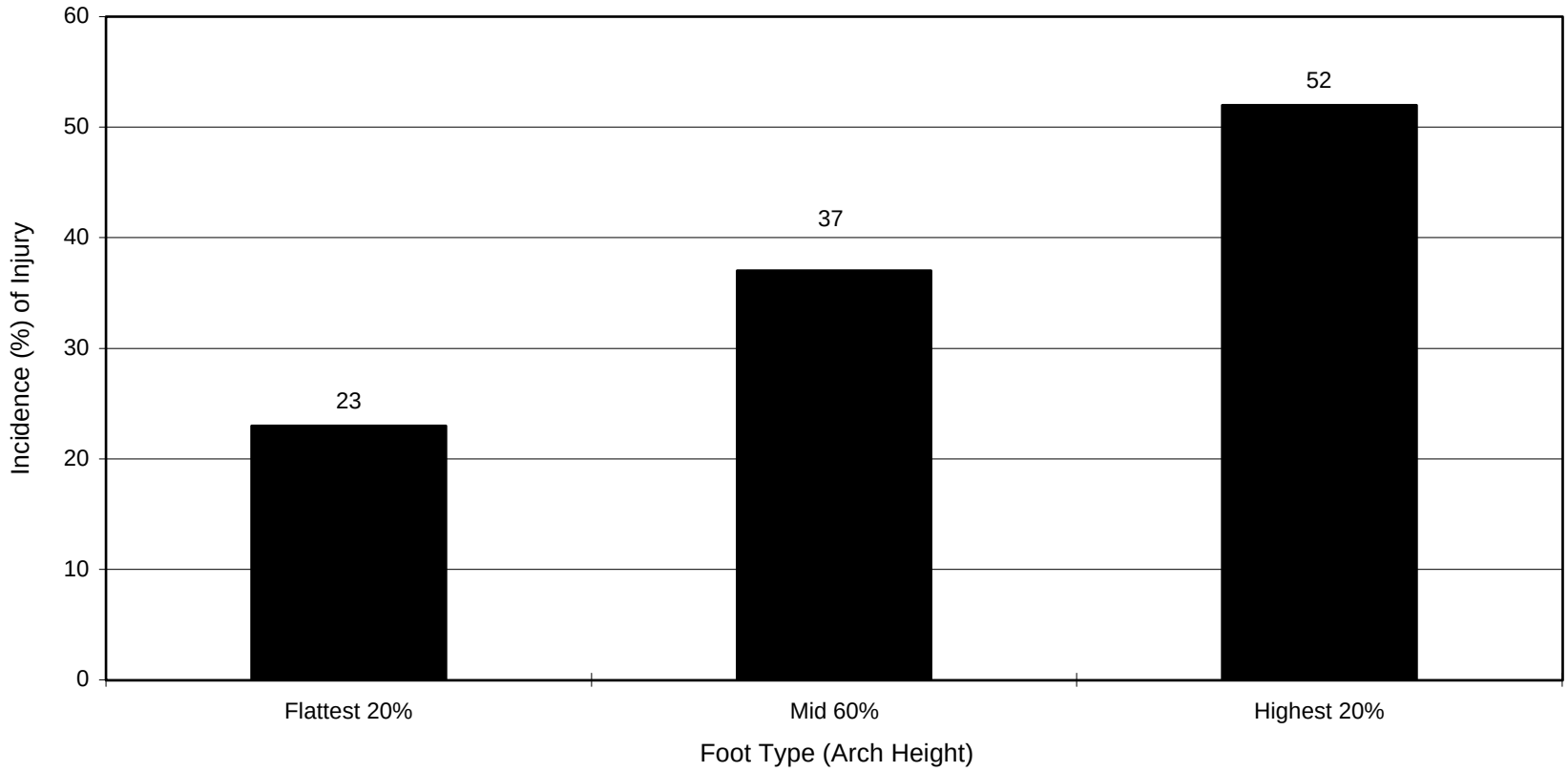
Figure 6-11

Adapted from Jones, B.H., D.N. Cowan, J.P. Tomlinson, et al. "Epidemiology of Injuries Associated with Physical Training Among Young Men in the Army." *Med. Sci. Sports Ex.* 25(2):197-203, 1993.

Figure 6-12 illustrates foot type (arch height) and incidence of lower extremity injuries among personnel in Army infantry initial entry training in 1987.

- Trainees with the highest arches had the highest injury incidence.
- Trainees with the flattest feet had the lowest injury incidence.

Army - Foot Type (Arch Height) and Incidence (%) of Lower Extremity Injuries Among Personnel in Infantry Initial Entry Training,* 1987



n = 246.
* 12 weeks, Fort Benning, GA.
Risk ratio (high vs. flat) = 2.3, p < .05.

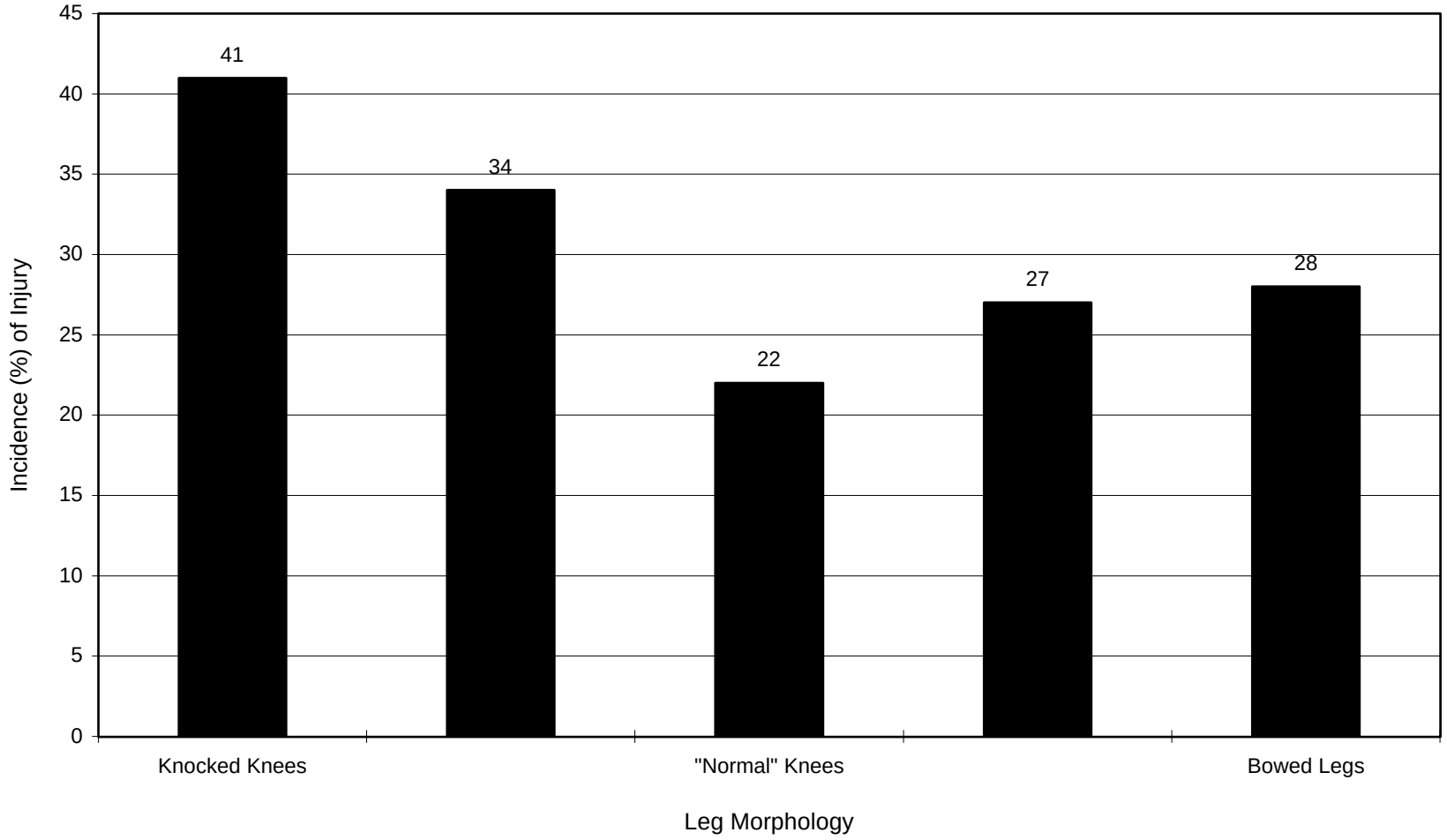
Source: Cowan, D.N., B.H. Jones, and J.R. Robinson. "Foot Morphologic Characteristics and Risk of Exercise-Related Injury." *Arch. Fam. Med.* 2:733-777, 1993.

Figure 6-12

Figure 6-13 illustrates knocked knees, bowed legs, and the incidence of any overuse injury among men in Army infantry initial entry training in 1987.

- Trainees with knocked knees had the highest injury risk (risk ratio = 1.9) compared to trainees with "normal" knees.

Army - Knocked Knees, Bowed Legs, and Incidence (%) of Any Overuse Injury Among Men in Infantry Initial Entry Training,* 1987



n = 294.
* 12 weeks, Fort Benning, GA.

Source: Cowan, D.N. et al. "Lower Limb Morphology and Risk of Overuse Injury Among Male Infantry Trainees." *Medicine and Science in Sports Exercise* 28(8):945-952, 1996.

Figure 6-13

Multiple Risk Factors.

Table 6-8 displays multiple logistic regression analysis for one or more injury visits regressed on demographic and fitness risk factors.

- The strongest predictor of injury is run time on the Army diagnostic physical fitness test.
- When fitness measures are included in the model, gender is not a strong predictor of injury risk.

Table 6-8. Army - Risk Factors for Injury Among Army Basic Trainees

Risk Factors		Odds Ratios*	95% Confidence Intervals
Sex	1 = Men	—	—
	2 = Women	1.14	0.48 - 2.72
Race	1 = Black	—	—
	2 = White	1.31	0.89 - 1.94
	3 = Other	0.84	0.40 - 1.79
Age	1 = <20	—	—
	2 = 20-24	1.50	1.00 - 2.23
	3 = 25+	1.26	0.69 - 2.31
Run Time†	1 = Fast	—	—
	2	1.47	0.68 - 3.18
	3 = Average	1.54	0.91 - 2.62
	4	2.52	1.26 - 5.04
	5 = Slow	3.23	1.59 - 6.58
Sit-ups	1 = High	—	—
	2	1.05	0.60 - 1.81
	3 = Average	0.80	0.44 - 1.44
	4	1.15	0.63 - 2.09
	5 = Low	1.51	0.78 - 2.92
Push-ups	1 = High	—	—
	2	1.62	0.90 - 2.92
	3 = Average	1.19	0.65 - 2.19
	4	1.34	0.66 - 2.71
	5 = Low	1.24	0.54 - 2.88
Strength	1 = High	—	—
	2	1.41	0.80 - 2.50
	3 = Average	1.61	0.90 - 2.88
	4	2.10	0.88 - 5.04
	5 = Low	2.11	0.83 - 5.36

n = 509 men and 352 women in basic combat training, Fort Jackson, SC, 1988.

* An odds ratio is a surrogate for a risk ratio and generally overestimates risk. It is used when a rate cannot be calculated.

† This was the only statistically significant risk factor for injury; (p) < .05.

Source: Bell, N.S., T.W. Mangione, D. Hemenway, P.J. Amoroso, and B. H. Jones. Injury Etiology and Prevention Selected Topics: High Injury Rates Among Female Trainees: A Function of Gender? DTIC # ADA306073. USARIEM, Natick, MA, 1996.

Table 6-9 displays risk factors for lower extremity musculoskeletal injuries among male Army trainees during infantry initial entry training.

- Age, cigarette use, past physical activity, and flexibility were predictors of injury risk, when controlling for the effects of other risk factors in this population of infantry trainees.

Table 6-9. Army - Risk Factors for Lower Extremity Musculoskeletal Injuries Among Male Trainees During Infantry Initial Entry Training

Factor		Lower Extremity Injuries Odds Ratio* (95% Confidence Intervals)
Age (years)	<24	1.0
	≥24	4.3 (2.0, 9.2)†
Cigarettes smoked per day	<10/day	1.0
	≥10 /day	1.9 (1.1, 3.3)†
History of Injury	No Injury	1.0
	Injury (no sprain)	0.6 (0.3, 1.3)
	Ankle Sprain	1.7 (0.9, 3.2)
Job Activity	Heavy - Moderate	1.0
	Light - Very Light	1.8 (1.0, 3.2)†
Past Physical Activity	Above Average	1.0
	Average or Less	2.2 (1.3, 3.8)†
Flexibility	1 = Lowest 20%	3.6 (1.5, 8.6)†
	2	1.7 (0.9, 5.4)
	3 = Mid 20%	1.0
	4	1.9 (0.8, 4.8)
	5 = Highest 20%	3.3 (1.3, 7.9)†
Training Unit	Low Mileage	1.0
	High Mileage	1.6 (0.9, 2.7)

n = 303 men in Army infantry initial entry training, Fort Benning, GA, 1987.

* An odds ratio is a surrogate for a risk ratio and generally overestimates risk. It is used when a rate cannot be calculated.

† $p \leq 0.05$ for odds ratio (comparison to baseline; baseline = factor with odds ratio of 1.0).

Source: Jones, B.H., D.N. Cowan, J.P. Tomlinson, et al. "Epidemiology of Injuries Associated with Physical Training Among Young Men in the Army." *Med. Sci. Sports Ex.* 25(2):197-203, 1993.

In the early 1990s, injuries among military parachutists were targeted for prevention. Ankle injuries associated with the forces of parachute landings were of particular concern. After an assessment of the general characteristics of and risk factors for these injuries, an off-the-shelf device, the parachute ankle brace (PAB), was chosen for a randomized injury intervention trial. This simple device was highly efficacious in reducing ankle sprains and also quite cost effective. Results of the first study* revealed:

- The incidence of inversion ankle sprains was 1.9% in non-brace wearers and 0.3% in brace wearers.
- Other injuries appeared unaffected by the brace.

The Army estimates that cost avoidance using these braces will be on the order of $2.5 million per year. The success of this intervention represents a good example of the benefits of a methodical and scientific approach to injury control.

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* Amoroso, Paul J. et al. "Braced for Impact: Reducing Military Paratroopers' Ankle Sprains Using Outside-the-Boot Braces." *Journal of Trauma: Injury, Infection, and Critical Care* 45(3):575-580 , 1998.

Table 6-10 displays the frequency of diagnosis codes for outpatient visits for active duty Army personnel at Fort Eustis, Virginia, from June 1996 to May 1997. The top five diagnosis codes for outpatient visits were:

- V codes—35% (16,429 visits).
- Musculoskeletal system—17.1% (8,026 visits).
- Injury—10.9% (5,108 visits).
- Respiratory system—6.7% (3,131 visits).
- Infectious and parasitic—5.2% (2,461 visits).

Injuries are not the only cause of concern in the basic training environment. However, in this population of active duty Army personnel, injury and musculoskeletal system conditions account for 28% of all outpatient visits.

Data are as reported in the Standard Ambulatory Data Record (SADR) from the Ambulatory Data System (ADS), which has not been fully implemented. Therefore, the data provided represent less than 50% of the total encounters. In the SADR, there are one to four diagnosis codes for each encounter. Each diagnosis code was counted, which means a single encounter may be counted up to four times.

Table 6-10. Army - Frequency of Outpatient Visits* by Principal Diagnosis Groups for Active Duty Personnel, June 1996 - May 1997

Principal Diagnosis Groups	ICD-9 Codes	Frequency of Visits	Percentage
V Codes	V01-V82	16,429	35.0%
Musculoskeletal System	710-739	8,026	17.1%
Injury	800-999	5,108	10.9%
Respiratory System	460-519	3,131	6.7%
Infectious & Parasitic	001-139	2,461	5.2%
Mental Disorders	290-319	2,273	4.8%
Nervous System	320-389	2,055	4.4%
Genitourinary System	580-629	1,936	4.1%
Ill-Defined Conditions	780-799	1,393	3.0%
Skin Diseases	680-709	1,316	2.8%
Digestive System	520-579	1,254	2.7%
Circulatory System	390-459	586	1.2%
Endocrine, Nutritional, & Metabolic	240-279	560	1.2%
Neoplasms	140-239	205	0.4%
Congenital Anomalies	740-759	127	0.3%
Blood & Blood Forming Organs	280-289	70	0.1%
Pregnancy	630-676	10	0.0%
Perinatal Period Conditions	760-779	2	0.0%
E Codes	E800-E999	2	0.0%
Total	—	46,944	99.9%

n (approximate) = 4,667.
* Outpatient clinics at McDonald Army Community Hospital, Fort Eustis, VA.
Source: SADR, Patient Administration Systems Biostatistics Activity.

6-6. Navy and Marine Corps

The medical research and surveillance of injuries in the Navy and Marine Corps has most thoroughly been applied to training populations where the impact of injuries is the greatest. This is due to the nature of military training which includes limited numbers of personnel going through high intensity activity, compressed into the shortest possible period of time. Any disruption of this process results in the inability to enroll new trainees, the interruption of an individual's progress, and an inability to fill operational personnel needs.

The Navy trains approximately 50,000 recruits per year (42,000 men and 8,000 women), and the Marine Corps trains approximately 42,000 recruits per year (40,000 men and 2,000 women). Other training programs which have a high impact from injuries are Marine Corps Officer Candidate training and basic underwater demolition/SEALS (BUD/S). These programs are very safe and result in few acute accidental injuries. The majority of the injuries are lower extremity overuse injuries, secondary to a dramatic change in physical activity. (Recent efforts have begun on a large scale attempt to transfer the technology developed to reduce injuries in training populations to the operational forces.)

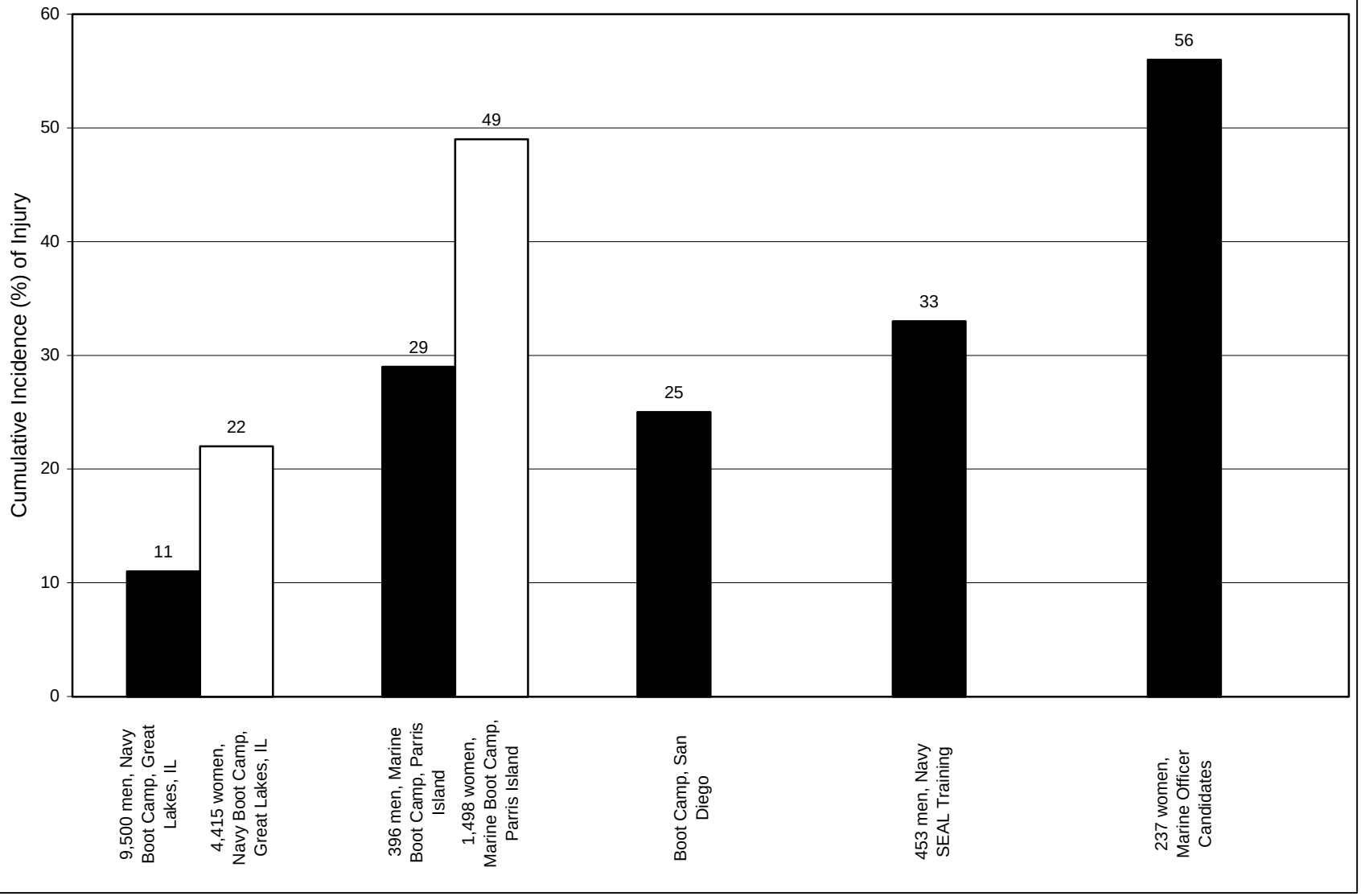
The Navy and Marine Corps data are presented in three parts:

- Incidence of injury is discussed on pages 6-56 through 6-63.
- Relative risks of injury/illness and rates of limited duty are discussed on pages 6-68 and 6-71.
- Risk factors are discussed on pages 6-72 through 6-83.

Incidence of Injury.

Figure 6-14 illustrates the incidence of injury among selected Navy and Marine Corps personnel during training in 1995. The percentage of trainees with at least one injury during training is directly related to the intensity of the training program. The length of each training program is varied: BUD/S is 24 weeks, Marine Corps recruit training is 11 weeks for men and 13 weeks for women, Navy basic training is 9 weeks, and Marine Corps Officer Candidate School is 10 weeks.

Navy and Marine Corps - Incidence (%) of Injury Among Selected Personnel During Training, 1995



Source: Naval Health Research Center, personal communication, 1996.

Figure 6-14

Table 6-11 displays the cumulative incidence of the most common injury diagnoses among men and women in Navy recruit training in 1996.

- Overuse injuries account for five of the top seven injury diagnoses.
- For both men and women, metatarsalgia is the most common injury diagnosis in recruit training.

Table 6-11. Navy - Cumulative Incidence (%) of the Most Common Injury Diagnoses Among Men and Women in Recruit Training,* 1996

Injury Diagnoses	Men Incidence (%)	Women Incidence (%)	Risk Ratio (women vs. men)
Metatarsalgia	2.3%	7.8%	3.4
Patellofemoral Syndrome	2.0%	3.3%	1.6
Ankle Sprain	1.8%	6.0%	3.3
Back Pain	1.6%	—	—
Plantar Fasciitis	1.3%	6.6%	5.1
Tendinitis - Ankle/Foot	1.3%	4.8%	3.7
Stress Fracture - Lower Extremity	0.8%	3.0%	3.7

n = not available.

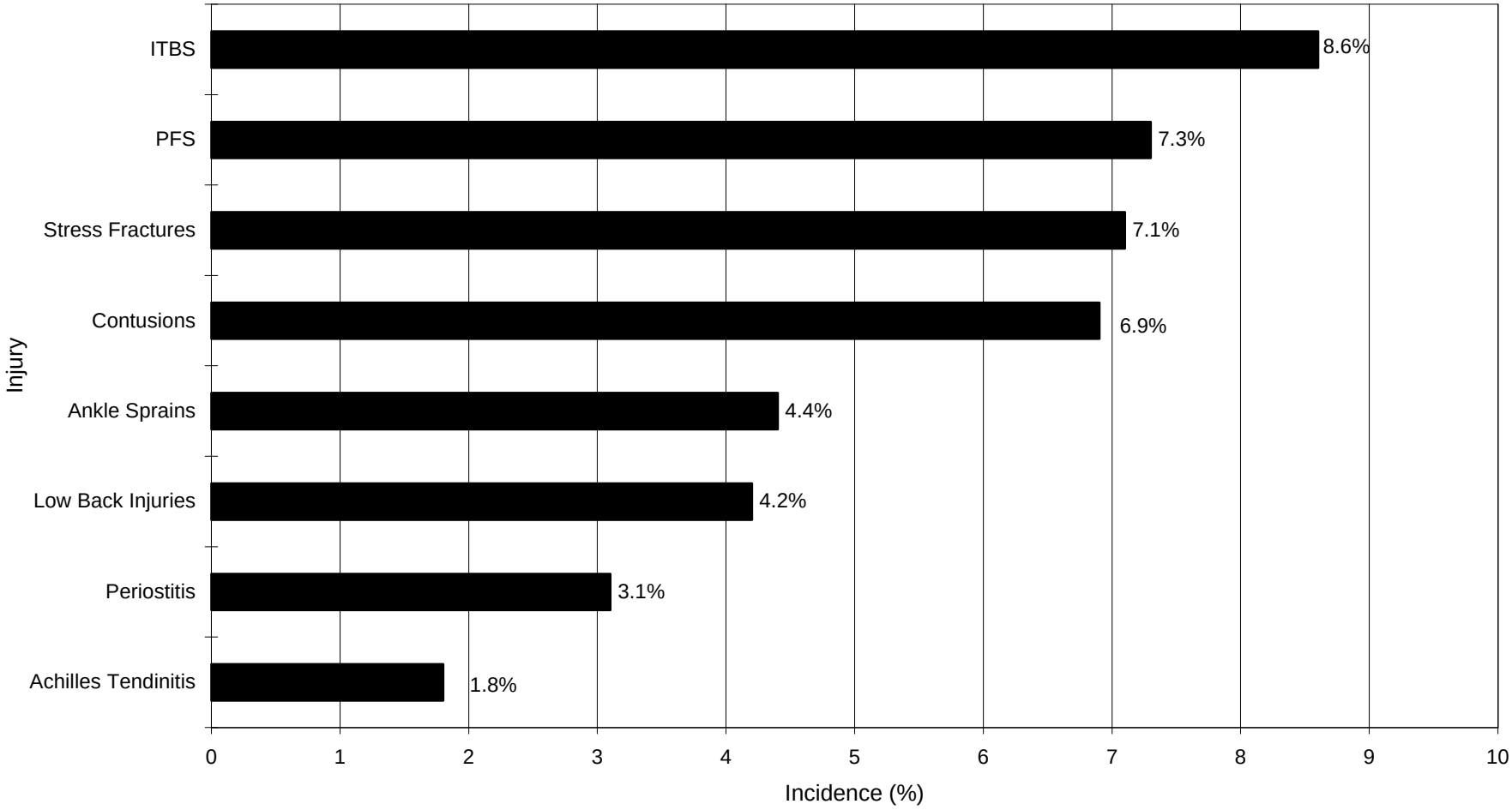
* 9 weeks, Great Lakes, IL.

Source: Naval Health Research Center, personal communication, 1997.

Figure 6-15 illustrates the most common musculoskeletal injury diagnoses among Navy SEAL trainees from May 1933 through June 1995.

- Iliotibial band syndrome (ITBS) was the most common injury diagnosis.
- Five of the top eight injury diagnoses were overuse injuries.

Navy - Most Common Musculoskeletal Injuries Among SEAL Trainees, May 1993 - June 1995



n = 451.

Source: Naval Health Research Center, personal communication, 1997.

Figure 6-15

Table 6-12 displays the most common injury diagnoses among men in Marine Corps recruit training in 1995.

- Ankle sprains were the most common injury during recruit training.
- Overuse injuries accounted for four of the top eight injuries for men.

Table 6-12. Marine Corps - Cumulative Incidence (%) of the Most Common Injury Diagnoses Among Men in Recruit Training,* 1995

Injury Diagnoses	Incidence (%)
Ankle Sprains	6.6%
Blister	6.0%
Cellulitis - Ankle/Foot	3.0%
Stress Fractures	2.2%
Iliotibial Band Syndrome	1.8%
Foot Pain	1.7%
Achilles Tendinitis	1.5%
Strain/Sprain - Knee/Leg	1.3%

n = 1,322 men.

* 11 weeks, Marine Corps Recruit Depot, San Diego, CA.

Source: Naval Health Research Center, personal communication, 1997.

Table 6-13 displays the cumulative incidence (%) of the most common injury diagnoses among women in Marine Corps recruit training in 1995.

- Ankle sprains were the most common injury during recruit training.
- Overuse injuries accounted for seven of the top eight injuries for women.

Table 6-13. Marine Corps - Cumulative Incidence (%) of the Most Common Injury Diagnoses Among Women in Recruit Training,* 1995

Injury Diagnoses	Incidence (%)
Ankle Sprains	8.7%
Shin Splints	5.9%
Stress Fractures	5.2%
Patellofemoral Syndrome	4.5%
Tendinitis - Ankle/Foot	4.1%
Patellar Tendinitis	3.8%
Iliotibial Band Syndrome	2.6%
Plantar Fasciitis	2.4%

n = 1,498 women.

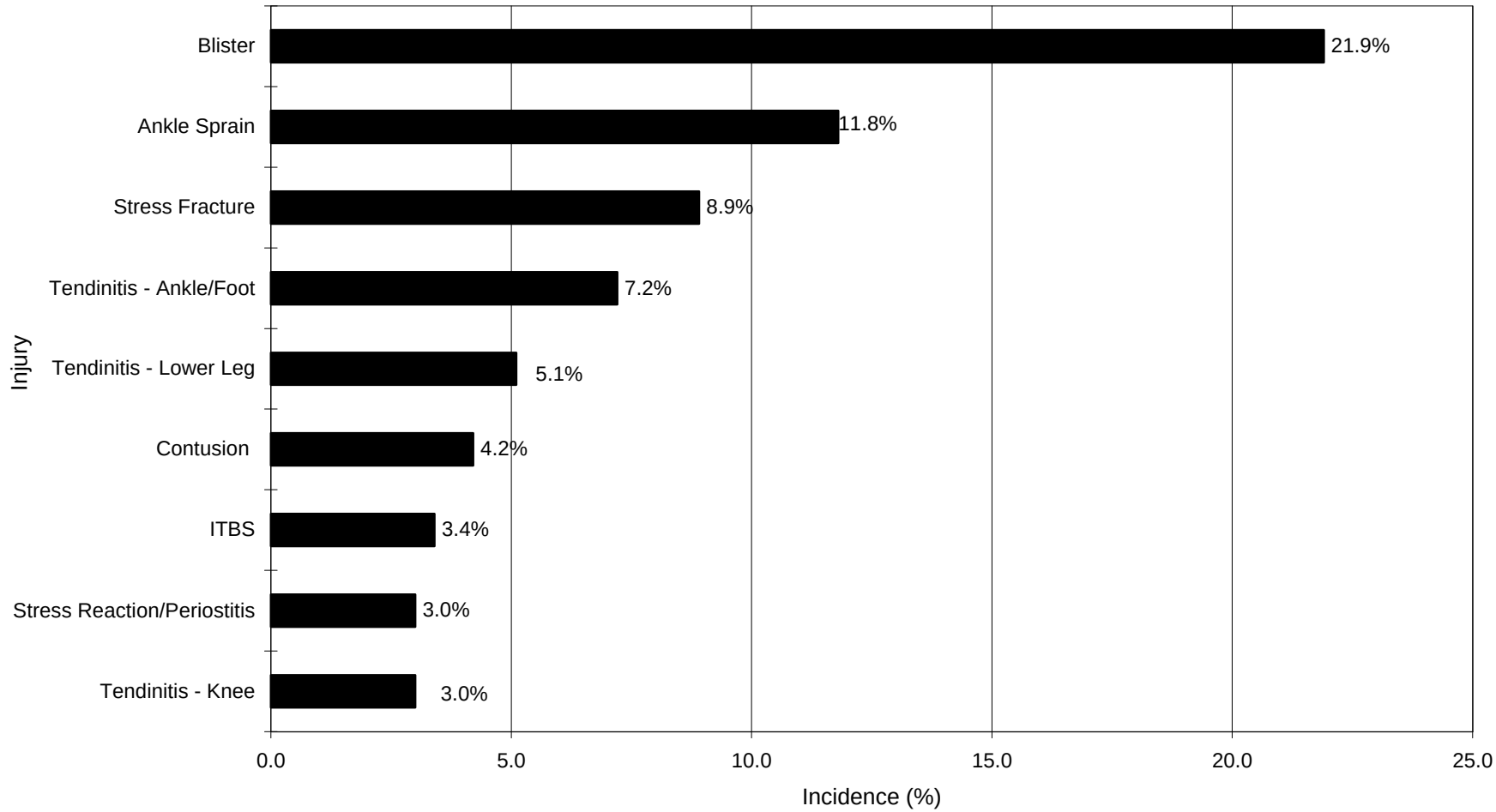
* 13 weeks, Marine Corps Recruit Depot, Parris Island, SC.

Source: Naval Health Research Center, personal communication, 1997.

Figure 6-16 illustrates the most common injury diagnoses among female officer candidates from 1994 through 1995.

- Blisters were the most common injury sustained among women during officer candidate training.
- Six of the top nine injury diagnoses were overuse injuries.

Marine Corps - Top Musculoskeletal Injuries among Female Officer Candidates, 1994 - 1995



n = 237.

Source: Naval Health Research Center, personal communication, 1997.

Figure 6-16

Relative Risks of Injury/Illness.

Table 6-14 displays the rates of injury and illness among men and women in Marine Corps recruit training in 1993.

- Women experienced twice the rate of injury clinic visits during recruit training compared to men.
- During recruit basic training, men experienced 40% fewer injury visits than for illness.
- During recruit basic training, the sick call rates for women were the same for injury and illness.

Table 6-14. Marine Corps - Rates of Injury and Illness Among Men and Women in Recruit Training,* 1993

Type	Rate (n/100/mo)		Rate Ratio†
	Injury	Illness	
≥ One sick call visit - Men	8.3	13.9	0.60
≥ One sick call visit - Women	16.3	16.3	1.0

n (men) = 434; n (women) = 366.

* 11 weeks for men and 13 weeks for women, Marine Corps Recruit Depot, Parris Island, SC.

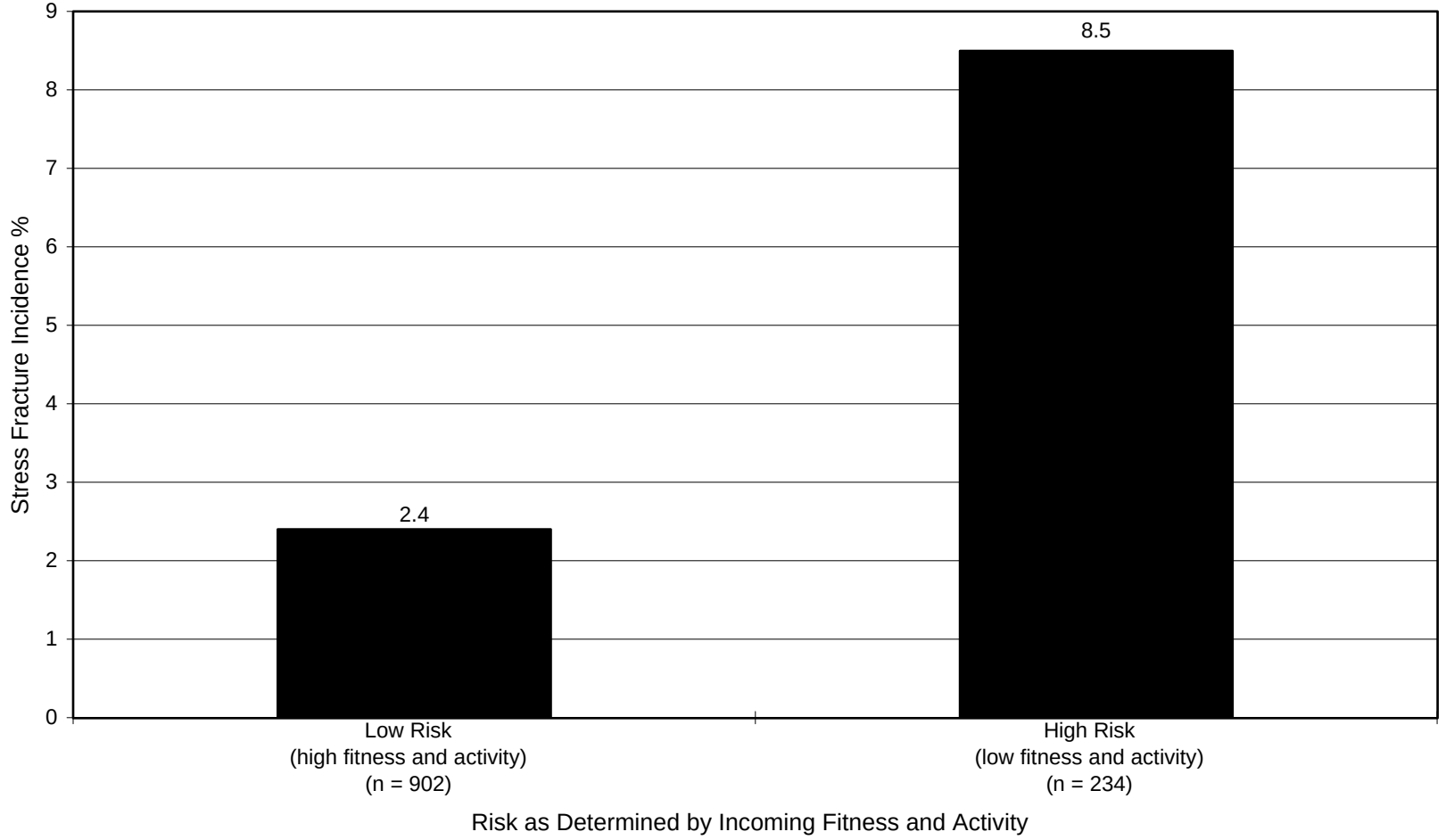
† Rate ratio = injury rate/illness rate.

Source: Kimsey, C.D., Jr. The Epidemiology of Lower Extremity Injuries in U.S. Marine Corps Recruits. Doctoral thesis, University of South Carolina School of Public Health, 1993.

Figure 6-17 illustrates the stress fracture incidence among male Marine Corps recruits in 1994 according to incoming physical fitness and recent physical activity.

- Recruits were classified as either high or low risk for stress fracture based on their response to five self-reported questions about physical activity and the time from a maximal effort 1.5 mile run upon arrival at training.
- High-risk recruits, who were the least physically active prior to training, and ran slower than an 8-minute mile upon arrival at training, were 3.5 times more likely to develop a stress fracture during training.

Marine Corps - Incidence of Stress Fracture Among Physical Fitness*/ Activity Categories in Men in Recruit Training, 1994



n = 1,136.
Risk ratio (faster vs. slower) = 3.5; confidence interval = 1.95 - 6.61.
* Fitness as measured by questionnaire and run time.

Source: Shaffer, R.A.; Brodine, S.K.; Almeida, S.A.; Williams, K.M.; Ronaghy, S. 1999. "Use of Simple Measures of Physical Activity to Predict Stress Fractures in Young Men Undergoing a Rogorous Physical Training Program." *Am. J. Epidemiology* 149(3):236-242.

Figure 6-17

Risk Factors.

Table 6-15 displays the evaluation of mileage, stress fracture incidence, and final fitness among men in Marine Corps recruit training in 1995.

- The improvement in aerobic performance, or run time, with increased mileage was not substantial.
- The incidence of stress fractures slightly increased as distance run increased.

Table 6-15. Marine Corps - Evaluation of Mileage, Stress Fracture Incidence, and Final Fitness Among Men in Recruit Training,* 1995

Subjects (n)	Distance Run* (miles)	Stress Fracture (%)	Final 3-Mile Run Time (Mean)
1,136	55	3.7%	20:20
1,117	41	2.7%	20:44
1,097	33	1.7%	20:53

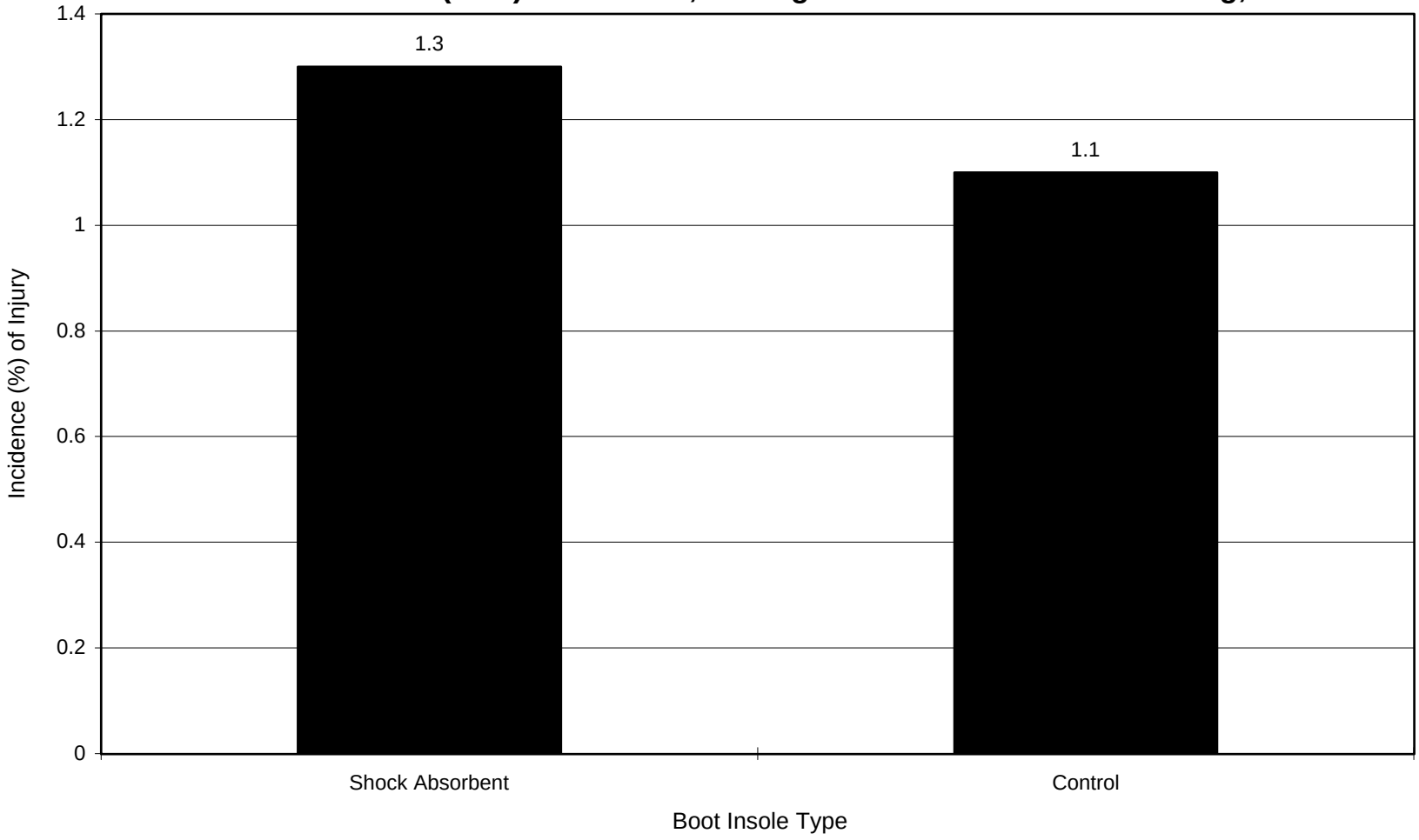
* Total organized running during recruit training, 11 weeks.

Source: American College of Sports Medicine 43rd annual meeting, "The Epidemiology of Fitness, Training, and Exercise-Related Injuries: A Military Perspective," Cincinnati, Ohio, June 1996.

Figure 6-18 illustrates the incidence of injury for stress fractures by insole type, shock absorbent (test) versus control, among personnel in Marine Corps recruit training in 1985.

- This is an example of a study that modified an extrinsic factor (footwear) in order to prevent injuries.
- In this study, incidence of stress fractures was not decreased with use of a shock-absorbent insole.

Marine Corps - Incidence (%) of Injury for Stress Fractures by Insole Type, Shock Absorbent (Test) vs. Control, Among Personnel in Recruit Training,* 1985



n = 3,025 (1,555 test, 1,470 control).
* 12 weeks. Marine Corps Recruit Depot, Parris Island, SC.
Risk ratio = (test/control) = 1.17, p = n.s.

Source: Gardner LI, et.al. Prevention of Lower Extremity Stress Fractures: A Controlled Trial of a Shock Absorbent Insole. Am J Public Health, 78:1563-1567, 1988.

Figure 6-18

Table 6-16 displays the associations of personal characteristics and smoking with lower extremity musculoskeletal injuries for men in Marine Corps recruit training in 1993.

- Among the 434 men studied, smoking history showed the strongest and the only statistically significant association with injury compared to other personal characteristics.

Table 6-16. Marine Corps - Associations of Personal Characteristics and Smoking with Lower Extremity Musculoskeletal Injury Among Men in Recruit Training,* 1993

Variables	Odds Ratio†	95% Confidence Interval
Age (1 year)	1.18	0.97, 1.43
Ethnicity		
Black	1.00	—
White	1.07	0.58, 1.98
Other	1.59	0.61, 4.15
Body Mass Index		
Q1 (lowest)	1.00	—
Q2	0.66	0.34, 1.29
Q3	0.94	0.50, 1.79
Q4 (highest)	0.83	0.43, 1.58
Arch Type		
Normal	1.00	—
Not Normal	1.08	0.63, 1.86
Smoking History (past 12 months)		
No	1.00	—
Yes	2.25	1.45, 3.50‡
Number Cigarettes Smoked		
1-9	1.00	—
≥ 10	0.82	0.39, 1.75

n = 434.

* 11 weeks, Marine Corps Recruit Depot, Parris Island, SC.

† An odds ratio is a surrogate for a risk ratio and generally overestimates risk. It is used when a rate cannot be calculated.

‡ Significant $p < .05$.

Source: Kimsey, C.D., Jr. The Epidemiology of Lower Extremity Injuries in U.S. Marine Corps Recruits. Doctoral thesis, University of South Carolina School of Public Health, 1993.

Table 6-17 displays the associations of personal characteristics and smoking with lower extremity musculoskeletal injuries among women in Marine Corps recruit training in 1993.

- Among the 366 women studied, smoking history showed the strongest and the only statistically significant association with injury compared to other personal characteristics.

Table 6-17. Marine Corps - Associations of Personal Characteristics and Smoking with Lower Extremity Musculoskeletal Injury Among Women in Recruit Training,* 1993

Variables	Odds Ratio†	95% Confidence Interval
Age (1 year)	0.96	0.85, 1.09
Ethnicity		
Black	1.00	—
White	1.27	0.68, 2.36
Other	1.11	0.54, 2.99
Body Mass Index		
Q1 (lowest)	1.00	—
Q2	0.93	0.48, 1.81
Q3	0.96	0.49, 1.86
Q4 (highest)	0.82	0.42, 1.60
Arch Type		
Normal	1.00	—
Not Normal	1.37	0.79, 2.37
Smoking History (past 12 months)		
No	1.00	—
Yes	1.74	1.09, 2.76‡
Number Cigarettes Smoked		
1-9	1.00	—
≥ 10	1.17	0.53, 2.59
Regular Menstrual Periods		
Yes	1.00	—
No	0.98	0.61, 1.57

n = 366.

* 13 weeks, Marine Corps Recruit Depot, Parris Island, SC.

† An odds ratio is a surrogate for a risk ratio and generally overestimates risk. It is used when a rate cannot be calculated.

‡ Significant $p < .05$.

Source: Kimsey, C.D., Jr. The Epidemiology of Lower Extremity Injuries in U.S. Marine Corps Recruits. Doctoral thesis, University of South Carolina School of Public Health, 1993.

Table 6-18 displays a regression model for the relationship between initial fitness and lower extremity musculoskeletal injury among men in Marine Corps recruit training in 1993.

- Run time on the initial physical fitness test, smoking history, and exercise level prior to boot camp were predictors of lower extremity musculoskeletal injury risk among these recruits.

Table 6-18. Marine Corps - Association* Between Initial Fitness and Lower Extremity Musculoskeletal Injury Among Men in Recruit Training,† 1993

Variables	Odds Radio	95% Confidence Interval
Initial fitness (first run time)		
Q1 (fastest)	1.00	—
Q2	2.07	1.02, 4.18
Q3	1.26	0.60, 2.64
Q4 (slowest)	2.11	1.05, 4.26
Smoking History (smoked in past 12 months)		
no	1.00	—
yes	2.09	1.29, 3.37
Exercise Change Prior to Boot Camp		
exercised more	1.00	—
maintained same amount or decreased	1.70	1.02, 2.83
Past exercise injury		
no	1.00	—
yes	1.56	0.96, 2.54

n = 369 men.

* Full model also included physical activity history, age, body mass index, ethnicity, occupational activity, exercise, exercise intensity, and self-rated fitness, none of which were significant predictors of injury.

† 11 weeks, Marine Corps Recruit Depot, Parris Island, SC.

Source: Kimsey, C.D., Jr. The Epidemiology of Lower Extremity Injuries in U.S. Marine Corps Recruits. Doctoral thesis, University of South Carolina School of Public Health, 1993.

Table 6-19 displays a regression model for the relationship between initial fitness and lower extremity musculoskeletal injury among women in Marine Corps recruit training in 1993.

- The only predictor of injury for women in Marine Corps recruit training was initial run time.
- Women demonstrating low aerobic fitness (as measured by run time) on the initial physical fitness test were at increased risk of injury.

Table 6-19. Marine Corps - Association* Between Initial Fitness and Lower Extremity Musculoskeletal Injury Among Women in Recruit Training,† 1993

Variables	Odds Ratio‡	95% Confidence Interval
Initial fitness (first run time)		
Q1 (fastest)	1.00	—
Q2	2.18	1.07, 4.43
Q3	2.17	1.05, 4.45
Q4 (slowest)	2.44	1.18, 5.07

n = 265 women.

* Full model also included physical activity history, age, body mass index, smoking history, ethnicity, past exercise/sports exercise intensity, self-rated fitness, and regular menstrual periods, none of which were significant predictors of injury.

† 13 weeks, Marine Corps Recruit Depot, Parris Island, SC.

‡ An odds ratio is a surrogate for a risk ratio and generally overestimates risk. It is used when a rate cannot be calculated.

Source: Kimsey, C.D., Jr. The Epidemiology of Lower Extremity Injuries in U.S. Marine Corps Recruits. Doctoral thesis, University of South Carolina School of Public Health, 1993.

6-7. Air Force

The Air Force data are presented in two parts:

- Incidence of injury is discussed on pages 6-84 and 6-85.
- Relative risks of injury/illness are discussed on pages 6-86 through 6-89.

Incidence of Injury.

Table 6-20 displays the cumulative incidence of injuries among Air Force men and women in basic training in 1995**.**

- Female recruits had more than twice the incidence of injury compared to male recruits.

Table 6-20. Air Force - Cumulative Incidence (%) of Injuries Among Men and Women in Basic Training,* 1995

	Men (n = 8,656)		Women (n = 5,250)	
	Percentage	95% Confidence Interval	Percentage	95% Confidence Interval
Injured at least once	15.0%	14.2, 15.7	32.8%	31.5, 34.0

* 6 weeks, Lackland AFB, TX.

Source: Snedecor, M.R.; Boudreau, C.F.; Ellis, B.E.; Roth, L.M.; Schulman, J. 1996. Injury and Illness Among Air Force Military Recruits. Office for Prevention and Health Services Assessment (OPHSA), Brooks AFB, TX. DTIC # ADA 327527.

Relative Risks of Injury/Illness.

Table 6-21 displays the rates of injury and illness among men and women in Air Force basic training in 1995.

- Female recruits had more than twice the risk of injury compared to male recruits.
- Female recruits had a 60% greater risk of illness compared to male recruits.
- Knee injuries and blisters ranked as one of the top three injury rates for both men and women.
- Respiratory condition rates were considerably higher than other illness rates for both men and women.

Table 6-21. Air Force - Rates of Injury and Illness Among Men and Women in Basic Training,* 1995

Injuries/Illnesses	Men (n = 8,656)		Women (n = 5,250)	
	Rate (n/1,000/week)	95% Confidence Interval	Rate (n/1,000/week)	95% Confidence Interval
All Encounters	65.0	63.2, 66.9	109.5	106.9, 112.1
All Injuries	27.8	26.4, 29.2	63.0	60.6, 65.5
Specific Injuries				
Blisters	5.8	5.1, 6.5	15.9	14.5, 17.3
Trunk/back/neck/chest/shoulder/arms	5.0	4.4, 5.7	9.2	8.1, 10.3
Knee injuries	4.9	4.3, 5.6	12.2	11.0, 13.5
Ankle and foot, excluding blisters	4.8	4.2, 5.4	16.7	15.2, 18.1
Hip and other leg injuries	2.6	2.1, 3.0	7.6	6.6, 8.6
Lacerations and contusions	2.5	2.1, 3.0	5.8	4.9, 6.7
All Illnesses	48.8	47.1, 50.5	77.9	75.4, 80.5
Specific Illnesses				
Respiratory conditions	30.0	28.6, 31.5	41.9	39.8, 44.1
Dermatological	9.5	8.6, 10.3	14.9	13.5, 16.2
Gastrointestinal	4.6	4.0, 5.2	12.0	10.8, 13.3
Psychological	2.4	2.0, 2.8	4.8	4.0, 5.7

* 6 weeks, Lackland AFB, TX.

Source: Snedecor, M.R.; Boudreau, C.F.; Ellis, B.E.; Roth, L.M.; Schulman, J. 1996. Injury and Illness Among Air Force Military Recruits. Office for Prevention and Health Services Assessment (OPHSA), Brooks AFB, TX. DTIC # ADA 327527.

Table 6-22 displays the distribution of the top 10 injuries among men and women in Air Force basic training in 1995.

- The highest percentage of injury clinic visits were due to blisters and knee pain for both men and women.
- Eight out of the top 10 injuries were lower extremity injuries.

Table 6-22. Air Force - Frequency and Distribution (%) of Top 10 Injuries Among Men and Women in Basic Training,* 1995

Injuries	Men (n = 1,329 injury visits)			Women (n = 1,743 injury visits)			Total (n = 3,072 injury visits)		
	Number of Visits	% of Injury Visits	Rank	Number of Visits	% of Injury Visits	Rank	Number of Visits	% of Injury Visits	Rank
Blisters - foot	325	24.5%	1	481	27.6%	1	806	26.2%	1
Joint/muscle/other pain - knee	201	15.1%	2	263	15.0%	2	464	15.1%	2
Sprains/strains - ankle	111	8.4%	4	197	11.3%	3	308	10.0%	3
Joint/muscle/other pain - ankle/foot	95	7.1%	5	190	10.9%	4	285	9.3%	4
Inflammation - ankle/foot	62	4.7%	9	151	8.7%	5	213	6.9%	5
Sprains/strains - shin splints/lower leg	75	5.6%	7	138	7.9%	6	213	6.9%	6
Joint/muscle/other pain - back	121	9.1%	3	84	4.8%	9	205	6.7%	7
Sprains/strains - knee	77	5.8%	6	107	6.1%	7	184	6.0%	8
Sprains/strains - trunk, back, neck	66	5.0%	8	105	6.0%	8	171	5.6%	9
Lacerations/contusions - lower limbs	58	4.4%	10	76	4.3%	10	134	4.4%	10

* 6 weeks, Lackland AFB, TX.

Source: Snedecor, M.R.; Boudreau, C.F.; Ellis, B.E.; Roth, L.M.; Schulman, J. 1996. Injury and Illness Among Air Force Military Recruits. Office for Prevention and Health Services Assessment (OPHSA), Brooks AFB, TX. DTIC # ADA 327527.